

SEARCH REQUEST FORM

Scientific and Technical Information Center

Requester's Full Name: Wesley Markham Examiner #: 78552 Date: 8/14/03
 Art Unit: 1762 Phone Number 30 6-7557 Serial Number: 10/019,278
 Mail Box and Bldg/Room Location: CP3 10A15 Results Format Preferred (circle) PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Method + Device For ECR plasma deposition of carbon nanofibInventors (please provide full names): Marc Delaunay } from Commissariat
Marie-Noelle Semeria } a l'energie atomiqueEarliest Priority Filing Date: 7/1/1999

For Sequence Searches Only Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.

Please search claims 27-40. For an electron cyclotron resonance (ECR) plasma CVD method of depositing carbon nanotubes onto a substrate. Preferably ① substrate does not have any catalyst, ② power for CVD is microwave and ③ ECR chamber has magnetic mirror.

nanotube synonyms: nanofiber, nanofibre, CNT, MWNT, SWNT, MWNT, SWCNT, buckytube, fullerene tube, nanofilament

Thanks a lot,
 Index Search - DialogWes

STAFF USE ONLY

	Type of Search	Vendors and cost where applicable
Searcher: <u>J Coline</u>	NA Sequence (#) _____	STN <u>✓</u>
Searcher Phone #: _____	AA Sequence (#) _____	Dialog _____
Searcher Location: _____	Structure (#) _____	Questel/Orbit _____
Date Searcher Picked Up: <u>8/19/03</u>	Bibliographic <u>✓</u>	Dr.Link _____
Date Completed: <u>8/19/03</u>	Litigation _____	Lexis/Nexis _____
Searcher Prep & Review Time: <u>60</u>	Fulltext _____	Sequence Systems _____
Clerical Prep Time: _____	Patent Family _____	WWW/Internet _____
Online Time: <u>60</u>	Other _____	Other (specify) _____

=> file hca

FILE 'HCA' ENTERED AT 14:10:30 ON 19 AUG 2003
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(FILE 'HOME' ENTERED AT 13:35:06 ON 19 AUG 2003)

FILE 'LCA' ENTERED AT 13:35:10 ON 19 AUG 2003

L1 1 SEA ABB=ON PLU=ON NANOTUB? OR SWNT OR MWNT OR SWCNT OR CNT
OR BUCKYTUB? OR (FULLERENE# OR NANO#) (2A) (TUB? OR FIBER# OR
PIP##### OR FILAMENT?) OR NANOPIP? OR NANOFILAMENT? OR
NANOFIBER? OR NANOFIBRE?

FILE 'HCA' ENTERED AT 13:36:44 ON 19 AUG 2003

L2 12205 SEA ABB=ON PLU=ON NANOTUB? OR SWNT OR MWNT OR SWCNT OR CNT
OR BUCKYTUB? OR (FULLERENE# OR NANO#) (2A) (TUB? OR FIBER# OR
PIP##### OR FILAMENT?) OR NANOPIP? OR NANOFILAMENT? OR
NANOFIBER? OR NANOFIBRE?

L3 107157 SEA ABB=ON PLU=ON (ELECTRON# OR CYCLOTRON?) (2A) RESONANC? OR
ECR

L4 92 SEA ABB=ON PLU=ON L2 AND L3

L5 723974 SEA ABB=ON PLU=ON PLASMA?

FILE 'LCA' ENTERED AT 13:38:42 ON 19 AUG 2003

L6 62 SEA ABB=ON PLU=ON CVD OR (CHEMICAL? OR CHEM) (2A) (VAPOR? OR
VAPOUR?) (2A) DEPOSIT? OR OMCVD OR MOCVD OR LPCVD OR PECVD OR
HFCVD OR ULPCVD OR PACVD OR PCVD

L7 115 SEA ABB=ON PLU=ON MIRROR?

L8 206 SEA ABB=ON PLU=ON MICROWAV?

L9 2958 SEA ABB=ON PLU=ON CHAMBER? OR COMPARTMENT? OR CAVIT? OR
REACTOR? OR VESSEL? OR HOUS?

FILE 'HCA' ENTERED AT 13:43:23 ON 19 AUG 2003

L10 91167 SEA ABB=ON PLU=ON CVD OR (CHEMICAL? OR CHEM) (2A) (VAPOR? OR
VAPOUR?) (2A) DEPOSIT? OR OMCVD OR MOCVD OR LPCVD OR PECVD OR
HFCVD OR ULPCVD OR PACVD OR PCVD

L11 49649 SEA ABB=ON PLU=ON MIRROR?

L12 83741 S L8

L13 1009393 SEA ABB=ON PLU=ON CHAMBER? OR COMPARTMENT? OR CAVIT? OR

REACTOR? OR VESSEL? OR HOUS?

L14 43 SEA ABB=ON PLU=ON L4 AND 1907-1999/PY, PRY

L15 2 SEA ABB=ON PLU=ON L14 AND L6

L16 6 SEA ABB=ON PLU=ON L14 AND L12

L17 1 SEA ABB=ON PLU=ON L14 AND L9

L18 6 SEA ABB=ON PLU=ON L15 OR L16 OR L17

L19 1669 SEA ABB=ON PLU=ON (COMMISSARIAT? AND FR#)/PA

L20 1 SEA ABB=ON PLU=ON L18 AND L19

L21 1 SEA ABB=ON PLU=ON L14 AND L19

D SCAN

L22 5 SEA ABB=ON PLU=ON L18 NOT L21

L23 37 SEA ABB=ON PLU=ON L14 NOT L18

L24 1 SEA ABB=ON PLU=ON L14 AND L13

L25 QUE ABB=ON PLU=ON PRODUC? OR PROD# OR GENERAT? OR MANUF? OR MFR# OR CREAT? OR FORM## OR FORMING# OR FORMAT? OR MAKE# OR MADE# OR MAKING# OR FABRICAT? OR SYNTHESI? OR PREPAR? OR PREP#

L26 18 SEA ABB=ON PLU=ON L23 AND L25

L27 16 SEA ABB=ON PLU=ON L26 AND ESR#

L28 1460462 SEA ABB=ON PLU=ON FABRIC? OR TEXTILE? OR CLOTH? OR TARN? OR WEAV? OR WOVE? OR WOOF? OR WEFT? OR WEB? OR WEB? OR SPIN? OR SPUN? OR FIBER?

L29 16 SEA ABB=ON PLU=ON L26 AND L28

L30 16 SEA ABB=ON PLU=ON L29 OR L27

L31 16 SEA ABB=ON PLU=ON L30 NOT L18

FILE 'JAPIO, WPIX' ENTERED AT 13:51:41 ON 19 AUG 2003

L32 6154 SEA ABB=ON PLU=ON L3

L33 3635 SEA ABB=ON PLU=ON L1

SET MSTEPS ON

L34 3 SEA ABB=ON PLU=ON L32 AND L33

L35 5 SEA ABB=ON PLU=ON L32 AND L33

TOTAL FOR ALL FILES

L36 8 SEA ABB=ON PLU=ON L32 AND L33

D SCAN

L37 3 SEA ABB=ON PLU=ON L34 AND 2001-2003/PY, PRY

L38 5 SEA ABB=ON PLU=ON L35 AND 2001-2003/PY, PRY

TOTAL FOR ALL FILES

L39 8 SEA ABB=ON PLU=ON L36 AND 2001-2003/PY, PRY

SET MSTEPS OFF

L40 55560 SEA ABB=ON PLU=ON L6

L41 153 SEA ABB=ON PLU=ON L1 AND L40

L42 3654439 SEA ABB=ON PLU=ON PRODUC? OR FABRIC? OR SYNTH? OR MFR#

L43 91 SEA ABB=ON PLU=ON L41 AND L42

L44 23 SEA ABB=ON PLU=ON L43 AND L9

L45 8 SEA ABB=ON PLU=ON L44 AND L8

L46 7 SEA ABB=ON PLU=ON L44 AND L28

L47 16 SEA ABB=ON PLU=ON L39 OR L45 OR L46

FILE 'COMPENDEX, INSPEC' ENTERED AT 13:59:39 ON 19 AUG 2003

L48 11412 SEA ABB=ON PLU=ON L1

L49 52691 SEA ABB=ON PLU=ON L3

L50 125 SEA ABB=ON PLU=ON L48 AND L49

L51 41 SEA ABB=ON PLU=ON L50 AND 1985-1999/PY

L52 39273 SEA ABB=ON PLU=ON L6

L53 96811 SEA ABB=ON PLU=ON L6

L54 975215 SEA ABB=ON PLU=ON L28

L55 215051 SEA ABB=ON PLU=ON L8

L56 2355278 SEA ABB=ON PLU=ON L42

L57 0 SEA ABB=ON PLU=ON L51 AND L6

L58 2 SEA ABB=ON PLU=ON L51 AND L53

L59 29 SEA ABB=ON PLU=ON L51 AND L54
 L60 1 SEA ABB=ON PLU=ON L59 AND L55
 L61 10 SEA ABB=ON PLU=ON L59 AND L56
 L62 12 SEA ABB=ON PLU=ON L58 OR L60 OR L61
 D SCAN
 L63 8 SEA ABB=ON PLU=ON L62 AND ESR
 L64 18 SEA ABB=ON PLU=ON L48 AND ECR
 L65 40 SEA ABB=ON PLU=ON L51 NOT L64
 L66 17 SEA ABB=ON PLU=ON L64 NOT L51
 L67 16 SEA ABB=ON PLU=ON L66 AND (L53 OR L54 OR L55 OR L56)

FILE 'HCA' ENTERED AT 14:10:30 ON 19 AUG 2003

=> d L21 cbib abs hitind

L21 ANSWER 1 OF 1 HCA COPYRIGHT 2003 ACS on STN

134:93659 Method and device for electronic **cyclotron**
resonance plasma deposit of carbon **nanofibre** layers in
 fabric form and resulting fabric layers. Delaunay, Marc; Semeria,
 Marie-Noelle (**Commissariat a l'Energie Atomique, Fr.**). PCT Int.
 Appl. WO 2001003158 A1 20010111, 51 pp. DESIGNATED STATES: W: JP, US;
 RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT,
 SE. (French). CODEN: PIXXD2. APPLICATION: WO 2000-FR1827 20000629.
 PRIORITY: FR 1999-8473 19990701.

AB The invention concerns a method and a device for electronic
cyclotron resonance plasma deposit of carbon
nanofibres or **nanotubes** in fabric form, on a
 catalyst-free substrate, by microwave power injection into a deposit
 chamber comprising a magnetic structure with a highly unbalanced magnetic
 mirror, and at least an electronic **cyclotron resonance**
 inside said deposit chamber itself and opposite said substrate, whereby,
 under pressure less than 10⁻⁴ mbar, the carbon-contg. gas in said magnetic
 mirror at the center of the deposit chamber is ionised and/or dissociated,
 thereby producing species which will be deposited on said substrate which
 is heated. The invention further concerns a layer, optionally on a
 substrate, formed of a fabric or array of carbon **nanofibres** or
nanotubes interconnected as in a web, said layer being
 catalyst-free and having multiple layers or a multilayer structure -
 comprising at least two layers of carbon **nanofibres** or
nanotubes in fabric form, and filters, nanogrids accelerating or
 decelerating electrons and flat displays comprising such layers or
 structures.

IC ICM H01J037-32

ICS H05H001-46; C01B031-02

CC 75-1 (Crystallography and Liquid Crystals)

Section cross-reference(s): 74, 76

ST **electron cyclotron resonance** plasma
 deposition carbon **nanofiber** layer fabric; method app ECR
 plasma deposition carbon **nanofiber** layer fabric

IT **Nanotubes**

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
 (Technical or engineered material use); PROC (Process); USES (Uses)
 (carbon; method and device for electronic **cyclotron**
resonance plasma deposit of carbon **nanofiber** layers
 in fabric form and resulting fabric layers)

IT Optical imaging devices

(flat screens; method and device for electronic **cyclotron**
resonance plasma deposit of carbon **nanofiber** layers
 in fabric form and resulting fabric layers for)

IT Textiles

- (method and device for electronic **cyclotron resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
- IT Carbon fibers, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method and device for electronic **cyclotron resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
- IT Vapor deposition process
(plasma; method and device for electronic **cyclotron resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)
- IT 74-82-8, Methane, processes 74-84-0, Ethane, processes 74-85-1, Ethene, processes 74-86-2, Acetylene, processes 1333-74-0, Hydrogen, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(method and device for electronic **cyclotron resonance** plasma deposit of carbon **nanofiber** layers in fabric form and resulting fabric layers)

=> d L22 1-5 cbib abs hitind

L22 ANSWER 1 OF 5 HCA COPYRIGHT 2003 ACS on STN

136:159188 Process for synthesizing one-dimensional nanosubstances by **electron cyclotron resonance chemical vapor deposition**. Shih, Han-Chang; Sung, Shing-Li; Tsai, Shang-Hua (Taiwan). U.S. US(6346303 B1 20020212, 12 pp. (English). CODEN: USXXAM. APPLICATION: US 1999-311598 19990514. PRIORITY: TW 1999-88100434 19990111.

AB The present invention provides a process for synthesizing 1-dimensional nanosubstances. A membrane having channels serves as the host material for the synthesis. The anodic membrane is brought into contact with a **microwave** excited plasma of a precursor gas using an **electron cyclotron resonance CVD** (**ECR=CVD**) system. Parallel aligned nanosubstances can be synthesized in the channels of the membrane over a large area. C nitride nanosubstances are synthesized successfully for the 1st time in the present invention.

IC ICM H05H001-18

ICS C23C016-32; C23C016-36

NCL 427571000

CC 75-1 (Crystallography and Liquid Crystals)

Section cross-reference(s): 57

ST carbon nanosubstance one dimensional synthesis **electron cyclotron resonance CVD**; nitride carbon nanotube synthesis **electron cyclotron resonance CVD**; nanofiber carbon synthesis **electron cyclotron resonance CVD**

IT **Electron cyclotron resonance**

(CVD; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)

IT **Nanotubes**

RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)

(carbon fibers; process for synthesizing 1D nanosubstances by

electron cyclotron resonance CVD)

IT Hydrocarbons, processes

- RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent) (carbon source; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT **Nanotubes**
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT **Vapor deposition process**
(**chem., electron cyclotron resonance**; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT Polymers, uses
RL: DEV (Device component use); USES (Uses)
(membrane; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD** including step of contacting membrane with MW excited plasma gas)
- IT Carbon fibers, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(**nanotube**; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT Nanostructures
(process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT 7439-90-9, Krypton, uses 7440-01-9, Neon, uses 7440-37-1, Argon, uses 7440-59-7, Helium, uses 7440-63-3, Xenon, uses
RL: NUU (Other use, unclassified); USES (Uses)
(activating gas; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT 1344-28-1, Alumina, uses 7631-86-9, Silica, uses
RL: DEV (Device component use); USES (Uses)
(membrane; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD** including step of contacting membrane with MW excited plasma gas)
- IT 7664-41-7, Ammonia, processes 7727-37-9, Nitrogen, processes
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(nitrogen source; process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- IT 154769-61-6P, Carbon nitride
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(process for synthesizing 1D nanosubstances by **electron cyclotron resonance CVD**)
- L22 ANSWER 2 OF 5 HCA COPYRIGHT 2003 ACS on STN
- 130:162353 Well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chemical vapor deposition**. Sung, S. L.; Tsai, S. H.; Tseng, C. H.; Chiang, F. K.; Liu, X. W.; Shih, H. C. (Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, 300, Taiwan). Applied Physics Letters, 74(2), 197-199 (English) 1999. CODEN: APPLAB. ISSN: 0003-6951. Publisher: American Institute of Physics.
- AB Vertically aligned C nitride **nanotubes** with a uniform diam. of

.apprx.250 nm were synthesized on a porous alumina membrane template (50-80 .mu.m thick) in a **microwave** excited plasma of C₂H₂ and N₂ using an **electron cyclotron resonance** CVD system. A neg. d.c. bias voltage was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nanochannels of the alumina template. This allowed the phys., and subsequent chem., absorption of species on the walls of the nanochannels that gave the C nitride **nanotubes**. The hollow structure and vertically aligned properties of the **nanotubes** were clearly verified by field-emission scanning electron microscope images. The absorption band between 1250 and 1750 cm⁻¹ in the FTIR spectroscopy spectrum proves that N atoms were incorporated into an amorphous network of C.

CC 78-8 (Inorganic Chemicals and Reactions)

ST carbon nitride **nanotube** prepn alumina substrate

IT **Vapor deposition** process

(chem., infiltration; well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

IT **Electron cyclotron resonance**

Nanotubes

(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

IT 74-86-2, Acetylene, reactions 7727-37-9, Nitrogen, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)

(reactant; well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

IT 1344-28-1, Alumina, uses

RL: NUU (Other use, unclassified); USES (Uses)

(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

IT 154769-61-6P, Carbon nitride

RL: SPN (Synthetic preparation); PREP (Preparation)

(well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chem. vapor deposition**)

L22 ANSWER 3 OF 5 HCA COPYRIGHT 2003 ACS on STN

129:116088 **Electronic** properties of single wall carbon **nanotubes**.

Petit, P.; Jouguet, E.; Parizel, N.; Fischer, J. E.; Thess, A.; Smalley, R. E. (Institut Charles Sadron, Strasbourg, 67000, Fr.). Molecular Nanostructures, Proceedings of the International Winterschool on Electronic Properties of Novel Materials, 11th, Kirchberg, Austria, Mar. 1-8, 1997, Meeting Date 1997, 435-438. Editor(s): Kuzmany, Hans. World Scientific: Singapore, Singapore. (English) 1998. CODEN: 66BSA7.

AB We report ESR and **microwave** resistivity measurements vs. T on bulk single wall carbon **nanotubes**. The results show that metallic resistivity is an intrinsic property of the material even at low temp. where d.rho./dT is neg. The data is consistent with one dimensional electronic transport.

CC 76-1 (Electric Phenomena)

ST **electronic** property single wall carbon **nanotube**

IT ESR (**electron spin resonance**)

Microwave

(ESR and **microwave** resistivity measurements vs. temp. on bulk

- single wall carbon **nanotubes**)
- IT **Nanotubes**
RL: PRP (Properties)
(carbon; electronic properties of single wall carbon **nanotubes**)
- IT Electronic properties
(electronic properties of single wall carbon **nanotubes**)
- IT 7440-44-0, Carbon, uses
RL: DEV (Device component use); USES (Uses)
(**nanotubes**; electronic properties of single wall carbon **nanotubes**)
- L22 ANSWER 4 OF 5 HCA COPYRIGHT 2003 ACS on STN
- 128:55740 **Electron spin resonance and microwave**
resistivity of single-wall carbon **nanotubes**. Petit, P.;
Jouguelet, E.; Fischer, J. E.; Rinzler, A. G.; Smalley, R. E. (Institut
Charles Sadron, 6, rue Boussingault, Strasbourg, 67000, Fr.). Physical
Review B: Condensed Matter, 56(15), 9275-9278 (English) 1997.
CODEN: PRBMDO. ISSN: 0163-1829. Publisher: American Physical Society.
- AB The thermal variations of ESR, d.c. resistivity and **microwave**
resistivity of unoriented bulk single-wall carbon **nanotubes** were
compared. The metallic high-temp. behavior involving a pos. temp. coeff.
of elec. resistivity is an intrinsic property of the bulk carbon, and the
system remains metallic even at low temps. and neg. temp. coeff. of
resistivity. The spin susceptibility is also independent of temp., and a
long mean-free path implies transport predominantly along the tube axes in
the bulk.
- CC 76-1 (Electric Phenomena)
Section cross-reference(s): 77
- ST carbon **nanotube microwave** resistivity ESR
- IT ESR (**electron spin resonance**)
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)
- IT **Nanotubes**
RL: PRP (Properties)
(carbon; ESR and **microwave** resistivity of single-wall carbon
nanotubes)
- IT Electric resistance
(d.c. and **microwave**; ESR and **microwave** resistivity
of single-wall carbon **nanotubes**)
- IT **Microwave**
(resistivity; ESR and **microwave** resistivity of single-wall
carbon **nanotubes**)
- IT 7440-44-0, Carbon, properties
RL: PRP (Properties)
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)
- L22 ANSWER 5 OF 5 HCA COPYRIGHT 2003 ACS on STN
- 127:256553 ESR and **microwave** resistivity studies of single wall
carbon **nanotubes**. Petit, P.; Jouguelet, E.; Fischer, J. E.;
Thess, A.; Smalley, R. E. (Institut Charles Sadron, Strasbourg, 67000,
Fr.). Proceedings - Electrochemical Society, 97-14(Recent Advances in the
Chemistry and Physics of Fullerenes and Related Materials), 1151-1156
(English) 1997. CODEN: PESODO. ISSN: 0161-6374. Publisher:
Electrochemical Society.
- AB The authors report ESR, d.c. and 10 GHz resistivity measurements on Single
Wall C **Nanotubes**. The measured resistivity is intrinsic to the
unoriented bulk material which is metallic down to low temps., and
strongly suggest that electronic transport occurs along the

nanotube axis.
CC 77-6 (Magnetic Phenomena)
Section cross-reference(s): 76
ST carbon **nanotube** ESR resistance; magnetic relaxation carbon
nanotube; electron diffusion carbon **nanotube**
IT ESR (**electron spin resonance**)
Electric resistance
Ferromagnetic resonance
Spin-spin relaxation
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)
IT Annealing
(annealing removal of cobalt and nickel from carbon **nanotubes**
)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; ESR and **microwave** resistivity of single-wall carbon
nanotubes)
IT Conduction electrons
(diffusion; in single-wall carbon **nanotubes**)
IT 7440-44-0, Carbon, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(ESR and **microwave** resistivity of single-wall carbon
nanotubes)
IT 7440-02-0, Nickel, processes 7440-48-4, Cobalt, processes
RL: OCU (Occurrence, unclassified); REM (Removal or disposal); OCCU
(Occurrence); PROC (Process)
(annealing removal of cobalt and nickel from carbon **nanotubes**
)

=> d L30 1-16 cbib abs hitind

L30 ANSWER 1 OF 16 HCA COPYRIGHT 2003 ACS on STN
132:101782 **Electron spin resonance** of purified
carbon **nanotubes**. Zhan, Yehong (Dep. Mathematics and Physics,
Guangdong Univ. Technology, Canton, 510090, Peop. Rep. China). Huaxue
Wuli Xuebao, 12(5), 575-578 (Chinese) 1999. CODEN: HWXUE4.
ISSN: 1003-7713. Publisher: Kexue Chubanshe.
AB The carbon **nanotubes** were **produced** by d.c.
arc-discharge method through helium and argon gas resp. at a controlled
pressure. The crude **nanotubes** were oxidized at 770.degree.
until .apprx.1% of the wt. remained and the purified **nanotubes**
were obtained. The **ESR** spectrum of purified carbon
nanotubes **prepd.** under different inert gases and their
pressures were measured. The dependence of the **ESR** line shape,
linewidth, g value of the purified **nanotubes** on the inert gases
and their pressures is found and discussed.
CC 77-6 (Magnetic Phenomena)
ST **ESR** purified carbon **nanotube**
IT **ESR** (**electron spin resonance**)
(**ESR** of purified carbon **nanotubes**)
IT **Nanotubes**
RL: PRP (Properties)
(carbon; **ESR** of purified carbon **nanotubes**)
L30 ANSWER 2 OF 16 HCA COPYRIGHT 2003 ACS on STN
131:280415 Reduction and **creation** of paramagnetic centers on
surfaces of three different polytypes of SiC. Macfarlane, P. J.; Zvanut,

M. E. (Department of Physics, University of Alabama at Birmingham, Birmingham, AL, 35294-1170, USA). Journal of Vacuum Science & Technology, B: Microelectronics and Nanometer Structures, 17(4), 1627-1631 (English) 1999. CODEN: JVTBD9. ISSN: 0734-211X. Publisher: American Institute of Physics.

- AB SiC is of interest to **create** power metal-oxide-semiconductor field-effect transistors because it can be thermally oxidized to **form** a SiO₂ dielec. layer. Previously, the authors used **ESR** to identify centers in 3C-SiC epilayer samples and 4H-SiC and 6H-SiC wafer samples after oxidn. and dry heat treatment [P. J. Macfarlane and M. E. Zvanut, Appl. Phys. Lett. 71, 2148(1997); Mater. Res. Soc. Symp. Proc. 513, 433(1998)]. The spectroscopic and thermal characteristics of these centers indicate that they are related to C. Because these centers are activated in a H₂O-poor ambient and are passivated in an ambient that is H₂O-rich, probably the activation mechanism is release of a hydrogenous species. The effect of repeated oxidns. on the concn. of heat-treatment-induced centers was studied. Samples are successively oxidized at 1150.degree. in O₂ bubbled through de-ionized water for 1, 2, 4, 8, and 16 h. After each oxidn., the samples are heat treated in dry (<0.1 ppm H₂O) N₂. Prior to the next oxidn., the oxide is removed. Upon oxidn. of the samples the authors observe an order of magnitude redn. in the concn. of centers that are present on the as-**prepd.** substrates. After each oxidn. centers are activated by dry heat treatment. Probably the centers present on the as-**prepd.** substrates are related to surface damage and are removed during the oxidn. as the surface SiC material is converted in the oxidn. **products.** Two models are offered for the source of the centers **generated** by dry heat treatment. The centers could be activated from C-H bonds related to damage like micropipes, **nanopipes**, or Si vacancies distributed throughout the SiC substrate, or they could arise from C-H bonds that **form** during the oxidn. The authors will discuss the merits of both of these models.
- CC 77-6 (Magnetic Phenomena)
Section cross-reference(s): 76
- ST silicon carbide polytype MOSFET **ESR** paramagnetic center
- IT **ESR (electron spin resonance)**
MOSFET (transistors)
Paramagnetic centers
Passivation
Polytypism
(redn. and **creation** of paramagnetic centers on surfaces of three different polytypes of SiC polytypes for MOSFET)
- IT 409-21-2, Silicon carbide, properties
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(redn. and **creation** of paramagnetic centers on surfaces of three different polytypes of SiC polytypes for MOSFET)
- L30 ANSWER 3 OF 16 HCA COPYRIGHT 2003 ACS on STN
- 131:152846 Effect of different inert gases and pressures on the **electron spin resonance** of carbon **nanotubes**. Zhang, Hai-Yan; He, Yan-Yang; Xue, Xin-Min; Liang, Li-Zheng; Wang, Jing (Dep. Mathematics Phys., Guangdong Univ. Technol., Canton, 510090, Peop. Rep. China). Wuli Xuebao, 48(7), 1354-1360 (Chinese) 1999. CODEN: WLHPAR. ISSN: 1000-3290. Publisher: Zhongguo Kexueyuan Wuli Yanjiuso.
- AB The **nanotubes** were **produced** by d.c. arc-discharge method through helium and argon gas at a controlled pressure ranging from 10 kPa to 80 kPa. The crude **nanotubes** were oxidized at 770.degree. until .apprx.1% of the wt. remained and the purified

nanotubes were obtained. The **ESR** of purified carbon **nanotubes prep'd.** under different inert gases with different pressures was measured. The dependence of **ESR** line shape, line-width, g value and **spin d.** of the purified **nanotubes** on different inert gases and pressure is found and discussed.

CC 77-6 (Magnetic Phenomena)

ST carbon **nanotube ESR** inert gas pressure effect

IT **Nanotubes**

RL: PRP (Properties)

(carbon; effect of different inert gases and pressures on the **ESR** of carbon **nanotubes**)

IT **ESR (electron spin resonance)**

(effect of different inert gases and pressures on the **ESR** of carbon **nanotubes**)

IT Noble gases, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)

(effect of different inert gases and pressures on the **ESR** of carbon **nanotubes**)

IT 7440-37-1, Argon, properties 7440-59-7, Helium, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)

(effect of different inert gases and pressures on the **ESR** of carbon **nanotubes**)

L30 ANSWER 4 OF 16 HCA COPYRIGHT 2003 ACS on STN

130:216606 Morphology and electronic properties of carbon **nanotubes**

synthesized by arc discharge in CF₄ gas. Yokomichi, H.; Sakima, H.; Matoba, M.; Ichihara, M.; Sakai, F. (Department of Electronics and Informatics, Toyama Prefectural University, Kosugi, 939-0398, Japan). Superlattices and Microstructures, 25(1/2), 487-491 (English) 1999 . CODEN: SUMIEK. ISSN: 0749-6036. Publisher: Academic Press.

AB The morphol. of C **nanotubes synthesized** by arc discharge in a CF₄ gas atm. was studied by SEM and TEM. The electronic properties of these **nanotubes** were studied by **ESR**.

The **synthesis** conditions in CF₄ gas were then compared with those in CH₄, H₂ and He based on these results. Also, the mechanism of tube growth in CF₄ gas was discussed briefly. (c) 1999 Academic Press.

CC 76-11 (Electric Phenomena)

Section cross-reference(s): 78

ST carbon **nanotube** electronic property morphol arc discharge

IT **Nanotubes**

RL: PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PRP (Properties); PREP (Preparation); PROC (Process)

(carbon; morphol. and electronic properties of carbon **nanotubes synthesized** by arc discharge in CF₄ gas)

IT Electric arc

Electronic properties

(morphol. and electronic properties of carbon **nanotubes synthesized** by arc discharge in CF₄ gas)

IT **ESR (electron spin resonance)**

Scanning electron microscopy

Transmission electron microscopy

(study on morphol. and electronic properties of carbon **nanotubes** by SEM, TEM and **ESR**)

IT 75-73-0, Carbon fluoride (CF₄)

RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)

(morphol. and electronic properties of carbon **nanotubes**)

synthesized by arc discharge in CF₄ gas)

L30 ANSWER 5 OF 16 HCA COPYRIGHT 2003 ACS on STN

130:147237 **Synthesis** of carbon **nanotubes** by **arc-discharge** in CF₄-gas-atmosphere. Yokomichi, Haruo; Matoba, Masaaki; Sakima, Hiroyuki; Ichihara, Masaki; Sakai, Fumiko (Department of Electronics and Informatics, Toyama Prefectural University, Toyane, 939-0398, Japan). Japanese Journal of Applied Physics, Part 1: Regular Papers, Short Notes & Review Papers, 37(12A), 6492-6496 (English) 1998. CODEN: JAPNDE. ISSN: 0021-4922. Publisher: Japanese Journal of Applied Physics.

AB Carbon **nanotubes** were **synthesized** by arc discharge in a CF₄ gas atm. involving fluorine atoms, which are able to terminate carbon bonding, while no fullerenes were **synthesized** in a CF₄ gas atm. The morphol. of these **nanotubes** was investigated by SEM and transmission electron microscopy (TEM). Based on these results, the **synthesized** conditions in CF₄ gas were compared with those in other gases, i.e., in CH₄, H₂, He and Ar gases. In addn., **ESR** (**ESR**) measurements were performed in order to obtain information about the electronic properties of these **nanotubes**.

CC 76-11 (Electric Phenomena)

ST carbon **nanotube synthesis** arc discharge tetrafluoromethane

IT **Nanotubes**

RL: PNU (Preparation, unclassified); PRP (Properties); PREP (Preparation) (carbon; **synthesis** of carbon **nanotubes** by arc discharge in CF₄ gas atm.)

IT **ESR (electron spin resonance)**

Electric arc

Electronic properties

Scanning electron microscopy

Transmission electron microscopy

(**synthesis** of carbon **nanotubes** by arc discharge in CF₄ gas atm.)

IT 75-73-0, Carbon fluoride (CF₄)

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)

(**synthesis** of carbon **nanotubes** by arc discharge in CF₄ gas atm.)

IT 7440-44-0P, Carbon, properties

RL: PNU (Preparation, unclassified); PRP (Properties); PREP (Preparation) (**synthesis** of carbon **nanotubes** by arc discharge in CF₄ gas atm.)

L30 ANSWER 6 OF 16 HCA COPYRIGHT 2003 ACS on STN

130:9819 **ESR** of purified carbon **nanotubes produced** under different helium pressures. Wong, S. P.; Zhang, Haiyan; Ke, Ning; Peng, Shaoqi (Department of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong, Peop. Rep. China). Materials Research Society Symposium Proceedings, 497(Recent Advances in Catalytic Materials), 151-156 (English) 1998. CODEN: MRSPDH. ISSN: 0272-9172. Publisher: Materials Research Society.

AB Carbon **nanotubes** were **prepd.** by the de arc-discharge method under a controlled helium pressure ranging from 10 to 80 kPa and subsequently purified by oxidn. in air. The purified carbon **nanotubes** were obsd. by TEM. The room temp. **ESR** spectra of the purified **nanotubes** were measured. The variations in the **ESR** line shape, g-value, linewidth and relative **spin d.** of the purified **nanotubes** on helium pressure were studied and discussed.

CC 77-6 (Magnetic Phenomena)

- ST carbon **nanotube** ESR helium pressure
IT Controlled atmospheres
 ESR (electron spin resonance)
 Transmission electron microscopy
 g-factor
 (**ESR of purified carbon nanotubes produced**
 under different helium pressures)
- IT **Nanotubes**
 Nanotubes
 RL: PRP (Properties)
 (carbon **fibers**; **ESR of purified carbon**
 nanotubes produced under different helium pressures)
- IT **Nanotubes**
 RL: PRP (Properties)
 (carbon; **ESR of purified carbon nanotubes**
 produced under different helium pressures)
- IT Carbon **fibers**, properties
 Carbon **fibers**, properties
 RL: PRP (Properties)
 (**nanotube**; **ESR of purified carbon nanotubes**
 produced under different helium pressures)
- IT 7440-59-7, Helium, uses
 RL: MSC (Miscellaneous); TEM (Technical or engineered material use); USES
 (Uses)
 (**ESR of purified carbon nanotubes produced**
 under different helium pressures)
- IT 7440-44-0, Carbon, properties
 RL: PRP (Properties)
 (**nanotubes**; **ESR of purified carbon**
 nanotubes produced under different helium pressures)

L30 ANSWER 7 OF 16 HCA COPYRIGHT 2003 ACS on STN

- 129:325184 Effects of different inert gas ambient on the **formation**
and **ESR spectra** of carbon **nanotubes**. Wong, S. P.;
Zhang, Haiyan; Ke, Ning; Peng, Shaoqi (Dept. of Electronic Engineering,
The Chinese University of Hong Kong, Hong Kong, Peop. Rep. China).
Proceedings - Electrochemical Society, 98-8 (Recent Advances in the
Chemistry and Physics of Fullerenes and Related Materials), 1312-1321
(English) 1998. CODEN: PESODO. ISSN: 0161-6374. Publisher:
Electrochemical Society.
- AB Carbon **nanotubes** were **prepd.** by the d.c. arc-discharge
method under a controlled helium or argon pressure ranging from 10 to 80
kPa and obsd. by TEM. Purifn. of the **nanotubes** were performed
by oxidn. in air at 770.degree. until .apprx.1% of the initial wt.
remained. The room temp. **ESR spectra** of the crude and purified
nanotubes were measured. The variations with the He or Ar
pressure in the size distribution of the crude carbon **nanotubes**
from TEM observations were compared, and the variations in the **ESR**
parameters with the gas ambient and pressure were studied.
- CC 78-1 (Inorganic Chemicals and Reactions)
- ST carbon **nanotube** **prepn** **ESR** diam distribution;
 ESR carbon nanotube helium argon effect; diam
 distribution **nanotube** helium argon effect; argon effect carbon
 nanotube diam distribution; helium effect carbon **nanotube**
 diam distribution
- IT **Nanotubes**
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
 (carbon; effects of different inert gas ambient on **formation**,
 ESR spectra and diam. distribution of carbon **nanotubes**
)

- IT **ESR (electron spin resonance)**
Size distributions
(effects of different inert gas ambient on **formation**,
ESR spectra and diam. distribution of carbon **nanotubes**
)
- IT 7440-37-1, Argon, uses 7440-59-7, Helium, uses
RL: NUU (Other use, unclassified); USES (Uses)
(effects of different inert gas ambient on **formation**,
ESR spectra and diam. distribution of carbon **nanotubes**
)
- L30 ANSWER 8 OF 16 HCA COPYRIGHT 2003 ACS on STN
129:116884 **ESR** and NMR studies on Li- and Na-doped C60 compounds and
lithiated carbon **nanotubes**. Menu, S.; Gaucher, H.; Conard, J.;
Lauginie, P.; Nozhov, A.; Nalimova, V. A. (CRMD-CNRS, Orleans, 45071,
Fr.). Molecular Nanostructures, Proceedings of the International
Winterschool on Electronic Properties of Novel Materials, 11th, Kirchberg,
Austria, Mar. 1-8, 1997, Meeting Date 1997, 262-265. Editor(s): Kuzmany,
Hans. World Scientific: Singapore, Singapore. (English) **1998**.
CODEN: 66BSA7.
- AB Applying high pressure to mixts. of fullerene powders and alkali metal
stoichiometric amts., the authors **synthesized** new alkali-C6060
compds., and Li carbon **nanotubes**. These compds. were studied
using **ESR**, 7Li, 13C, an NMR spectroscopies. The authors'
results on LixC60 compds. provide evidence of phases, with unexpectedly
high alkali contents, up to .apprx.50 Li per C60 mol. The authors report
also evidence of Li insertion between successive carbon sheets in
multiwalled carbon **nanotubes**.
- CC 77-6 (Magnetic Phenomena)
- ST magnetic resonance lithium sodium doped fullerene; NMR lithium sodium
doped fullerene; **ESR** lithium sodium doped fullerene
- IT **ESR (electron spin resonance)**
NMR (nuclear magnetic resonance)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and
lithiated carbon **nanotubes**)
- IT Alkali metals, properties
RL: PRP (Properties)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and
lithiated carbon **nanotubes**)
- IT 7439-93-2, Lithium, uses 7440-23-5, Sodium, uses
RL: MOA (Modifier or additive use); USES (Uses)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and
lithiated carbon **nanotubes**)
- IT 99685-96-8, [5,6]Fullerene-C60-Ih 141326-56-9 141326-57-0
RL: PRP (Properties)
(**ESR** and NMR studies on Li- and Na-doped C60 compds. and
lithiated carbon **nanotubes**)
- L30 ANSWER 9 OF 16 HCA COPYRIGHT 2003 ACS on STN
129:61911 Purification and magnetic properties of carbon **nanotubes**.
Bandow, S.; Asaka, S.; Zhao, X.; Ando, Y. (Japan Science Technology
Corporation, Department Physics, Meijo University, Nagoya, 468, Japan).
Applied Physics A: Materials Science & Processing, A67(1), 23-27 (English)
1998. CODEN: APAMFC. ISSN: 0947-8396. Publisher:
Springer-Verlag.
- AB Purifn. procedures for both multi- (**MWNTs**) and single-wall C
nanotubes (**SWNTs**) are introduced. Intermediate stages
in the purifn. procedure are monitored by SEM, which clearly shows the
increase of the **nanotube** content with increasing purifn. The
magnetic properties were investigated by **ESR**. Two kinds of

samples were used in the **ESR** measurements for **MWNTs** and for **SWNTs**. One is dispersed in hexane to **make** loosely contacting tubules and the other is a dried-deposited tubule to realize a close contacting tubule state. The **ESR** lineshape is closely related to the contact between **nanotubes**. The curved nature of the tube wall plays an important role in the explanation of the **ESR** properties.

CC 78-1 (Inorganic Chemicals and Reactions)

Section cross-reference(s): 77

ST carbon **nanotube** purifn **ESR**

IT **Nanotubes**

RL: PRP (Properties); PUR (Purification or recovery); PREP (Preparation) (carbon; purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

IT Filtration

(microfiltration; purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

IT Centrifugation

ESR (electron spin resonance)

Purification

(purifn. of single-wall and multi-wall C **nanotubes** by centrifugation and microfiltration sepn. and heat treatment and their **ESR** spectra)

L30 ANSWER 10 OF 16 HCA COPYRIGHT 2003 ACS on STN

128:175139 Carbon tubes discussed in a metallic ring model. Byszewski, Przemyslaw (Institute of Physics PAN, Warsaw, 02-668, Pol.). Journal of Physics and Chemistry of Solids, 58(11), 1685-1688 (English) 1997 . CODEN: JPCSAW. ISSN: 0022-3697. Publisher: Elsevier Science Ltd..

AB The similarity of the anisotropic properties of large diam. C tubes in a magnetic field to the anisotropy of graphite, suggests the use of a free electron model to describe their electronic structure in terms of the graphite band model. The diamagnetism of C tubes is discussed in terms of a model which accounts for the tubular deformation of graphite planes using the vector pseudopotential: $A_d = h/\rho \cdot 2[-y, x, 0]$, where ρ is the radius of the tube orientated along the z-axis. The deformation of the plane splits the energy band in two with opposite angular momentum, confinement on the tube excludes Landau quantization, and instead the field **generates** a net ring current.

CC 77-1 (Magnetic Phenomena)

ST carbon **nanotube** anisotropy ring model; band structure carbon

nanotube; magnetism carbon **nanotube**; **ESR**

carbon **nanotube**

IT Anisotropy

Band structure

Diamagnetism

ESR (electron spin resonance)

Electronic state

Magnetic anisotropy

Magnetic field effects

Magnetic moment

Pseudopotential

(anisotropy of properties of carbon tubes in magnetic field)

IT **Nanotubes**

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)

(carbon; anisotropy of properties of carbon tubes in magnetic field)

L30 ANSWER 11 OF 16 HCA COPYRIGHT 2003 ACS on STN

128:134843 Experimental verification of the dominant influence of extended carbon networks on the structural, electrical and magnetic properties of a common soot. Dunne, L. J.; Nolan, P. F.; Munn, J.; Terrones, M.; Jones, T.; Kathirgamanathan, P.; Fernandez, J.; Hudson, A. D. (Chemical Engineering Research Centre, South Bank University, London, SE1 0AA, UK). Journal of Physics: Condensed Matter, 9(48), 10661-10673 (English) 1997. CODEN: JCOMEL. ISSN: 0953-8984. Publisher: Institute of Physics Publishing.

AB Common soots are disordered carbonaceous materials contg. several percent of heteroatoms. A question of some importance is to what extent pure C networks dominate the properties of common soots. Here, the authors report the results of a comparative study of fullerene soots which are a **form** of pure partially ordered C and those **formed** from flaming polystyrene combustion which contain a few percent of O atoms, using electron diffraction, **ESR**, IR transmission and measurements of elec. cond. Despite some important characteristic differences, the annealed fullerene soot and flaming polystyrene soot have a no. of important structural, elec. and magnetic features in common, provided that the flame and annealing temps. are the same. Probably the graphitic layer and **fullerene** related **tubular** structures found in these materials dominate the elec. properties of these soots regardless of the presence of small quantities of heteroatoms in the soot derived from the flaming combustion of polystyrene.

CC 76-1 (Electric Phenomena)

Section cross-reference(s): 73, 77

ST soot carbon network structure cond magnetism; oxygen soot **ESR**; annealing fullerene soot property; optical absorption soot

IT Annealing

Combustion

ESR (electron spin resonance)

Electric conductivity

Flame

IR spectra

Optical absorption

Soot

Voids (structures)

(dominant influence of extended carbon networks on the structural, elec. and magnetic properties of a common soot)

IT Carbonaceous materials (technological **products**)

Fullerenes

RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)

(dominant influence of extended carbon networks on the structural, elec. and magnetic properties of a common soot)

L30 ANSWER 12 OF 16 HCA COPYRIGHT 2003 ACS on STN

127:340956 Nanometer-size tubes of carbon. Ajayan, P. M.; Ebbesen, T. W. (Department of Materials Science and Engineering, Rensselaer Polytechnic Institute, Troy, NY, 12180-3590, USA). Reports on Progress in Physics, 60(10), 1025-1062 (English) 1997. CODEN: RPPHAG. ISSN: 0034-4885. Publisher: Institute of Physics Publishing.

AB A review is presented on the present state of understanding of the structure, growth and properties of nanometer-size tubes of C with many refs. Two different types of C **nanotubes**, single-shell **nanotubes** made of single layers of graphene cylinders and multishell **nanotubes** made of concentric cylinders of graphene layers have now become available. The subtle structure parameters such as helicity in the C network and the nanometer diams. give the **nanotubes** a rich variety in phys. properties. Recent exptl. progress on the measurements of properties using EELS, Raman spectroscopy,

- electron-spin resonance**, elec. conductance, mech. stiffness and theor. predictions on electronic and mech. properties of **nanotubes** are discussed. In addn. to **synthesis** techniques, methods to purify and **make** aligned arrays of **nanotubes** will be described. Different approaches for **fabricating** composite structures using **nanotubes** as molds and templates and their future implications in materials science will be evaluated. Finally, promising areas of future applications, for example as tiny field-emitting devices, micro-electrodes, nanoprobe and H storage material will be outlined.
- CC 78-0 (Inorganic Chemicals and Reactions)
Section cross-reference(s): 65, 73, 75
- ST review carbon **nanotube** growth structure property
- IT **Nanotubes**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(carbon; structure and growth and properties of)
- IT Crystal growth
ESR (electron spin resonance)
Electric conductivity
Electrodes
Electron energy loss spectroscopy
Molecular structure
Purification
Raman spectra
Stiffness
(of carbon **nanotubes**)
- IT 7440-44-0P, Carbon, **preparation**
RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)
(structure and growth and properties of carbon **nanotubes**)
- L30 ANSWER 13 OF 16 HCA COPYRIGHT 2003 ACS on STN
127:313991 Room temperature **electron spin resonance** of the purified carbon **nanotubes** **produced** in different helium pressures. Zhang, Hai-Yan; Wang, Deng-Yu; Xue, Xin-Min; He, Yan-Yang; Wu, Ming-Mei; Peng, Shao-Qi (Dep. of Math. and Phys., Guangdong Univ. of Technol., Canton, 510090, Peop. Rep. China). Chinese Physics Letters, 14(8), 625-628 (English) 1997. CODEN: CPLEEU. ISSN: 0256-307X. Publisher: Chinese Physical Society.
- AB The **ESR** of purified carbon **nanotubes** **prepd.** under different helium pressures from 20.0 to 80.0 kPa in arc discharge was measured. The dependence of the **ESR spin d.**, linewidth and g value of the purified **nanotubes** on the helium pressure is found. The electronic properties of purified **nanotubes** varying with He pressure are discussed.
- CC 77-6 (Magnetic Phenomena)
- ST carbon **nanotube** **ESR** helium pressure
- IT Controlled atmospheres
ESR (electron spin resonance)
Nanotubes
(room temp. **ESR** of the purified carbon **nanotubes** **produced** in different helium pressures)
- IT 7440-59-7, Helium, uses
RL: MSC (Miscellaneous); TEM (Technical or engineered material use); USES (Uses)
(room temp. **ESR** of the purified carbon **nanotubes** **produced** in different helium pressures)
- IT 7440-44-0D, Carbon, **nanotubes**, properties
RL: PRP (Properties)

(room temp. **ESR** of the purified carbon **nanotubes**
produced in different helium pressures)

L30 ANSWER 14 OF 16 HCA COPYRIGHT 2003 ACS on STN

125:151566 Mechanical damage of carbon **nanotubes** by ultrasound. Lu, K. L.; Iago, R. M.; Chen, Y. K.; Green, M. L. H.; Harris, P. J. F.; Tsang, S. C. (Inst. of Chemistry, Academia Sinica, Taipei, Taiwan). Carbon, 34(6), 814-816 (English) 1996. CODEN: CRBNAH. ISSN: 0008-6223. Publisher: Elsevier.

AB The electron micrographs of sonicated **nanotubes** revealed a very high concn. of defects such as bending, buckling, fracture of graphene layers, and stripping of outer graphene layers. High-energy ultrasound caused more serious damage to carbon nanoparticles **producing** bundles of carbon ribbons; further sonication turned these to amorphous carbon. The extent of structural deformation in the tubes was solvent dependent; less damage was found in water or ethanol. The sonicated tube samples were studied by Raman and **ESR** spectroscopies confirming the structure findings. The oxidn. was studied of the carbon samples in stream of oxygen (0.2 g, 4% O₂ in He) with heating rate of 5.degree.C/min. The onset temp. was around 600.degree.C for freshly **prepd. nanotubes**, higher than that of graphite (.apprx. 540.degree.C); the onset temp. decreased with sonication (20 min) to .apprx. 500.degree.C.

CC 65-5 (General Physical Chemistry)

ST damage carbon **nanotube** ultrasound Raman **ESR**; oxidn
carbon **nanotube** damage ultrasound

IT Clusters

(carbon **nanotubes**; mech. damage of carbon **nanotubes**
and nanoparticles by ultrasound)

IT **Electron spin resonance**

Raman spectra

Sound and Ultrasound

(mech. damage of carbon **nanotubes** and nanoparticles by
ultrasound)

IT Oxidation

(mech. damage of carbon **nanotubes** and nanoparticles by
ultrasound and oxidn.)

IT Particles

(nano-, carbon; mech. damage of carbon **nanotubes** and
nanoparticles by ultrasound)

IT Carbon **fibers**, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)

(**nanotube**, mech. damage of carbon **nanotubes** and
nanoparticles by ultrasound)

IT 7440-44-0, Carbon, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)

(**nanotubes**; mech. damage of carbon **nanotubes** and
nanoparticles by ultrasound)

L30 ANSWER 15 OF 16 HCA COPYRIGHT 2003 ACS on STN

124:304093 Electrical, magnetic and structural characterization of fullerene soots. Dunne, L. J.; Sarkar, A. K.; Kroto, H. W.; Munn, J.; Kathirgamanathan, P.; Heinren, U.; Fernandez, J.; Hare, J.; Reid, D. G.; Clark, A. D. (School Chemistry and Molecular Sciences, Univ. Sussex, Brighton, BN1 9QJ, UK). Journal of Physics: Condensed Matter, 8(13), 2127-41 (English) 1996. CODEN: JCOMEL. ISSN: 0953-8984. Publisher: Institute of Physics Publishing.

AB Although it is some five years since fullerenes were extd. in a

macroscopic quantities from the black, superficially amorphous sooty deposits **produced** by a C arc under He, little is known in detail about the structure of the deposit or its elec. and magnetic properties. Here the authors provide evidence that this deposit, known as fullerene soot, is composed of defective networks of C atoms which do not have all valencies satisfied. The authors have studied these soots, before and after thermal annealing, using x-ray and electron diffraction,

electron spin-resonance (ESR)

spectroscopy, IR transmission and measurements of elec. cond. Localized states assocd. with such dangling bonds are removed from the soot on annealing and this process is accompanied by an ordering transition which modifies the elec. and magnetic properties. The fullerene soot particles appear to be encapsulated aggregates of highly defective C 'onions'. Such metastable defective networks undergo a subtle ordering processes upon heat treatment which is accompanied by a rise in the elec. cond. and a loss of paramagnetism due to the elimination of unsatisfied C atom valencies. Elec. cond. and IR transmission measurements indicate that the center of these 'onions' is graphitic, with metallic properties. The temp. dependence of the elec. cond. suggests that charge transport in both annealed and unannealed materials occurs by tunneling between metallic islands in the sample. The **ESR** linewidth, arising from the **spin** centers in fullerene soots, is not significantly changed by exposure to O. Probably the free radical centers in fullerene soots are extremely efficiently isolated from the atm.-presumably by encapsulation. This behavior contrasts with that of amorphous carbons **prepd.** by thermal decompn. of org. materials (chars). The **ESR** g-factors of the fullerene soots are lower than those of chars, which suggests that the radicals in fullerene soots have strong sigma character due to unsatisfied sp²-type valencies. A plausible structure and assocd. annealing mechanism for the fullerene soot is presented based on these exptl. observations.

CC 76-11 (Electric Phenomena)

Section cross-reference(s): 65, 77

IT Annealing

Electric conductivity and conduction

Electron spin resonance

Infrared spectra

Magnetic susceptibility

Optical absorption

Order

Soot

Tunneling

g-factor

(structure and properties of fullerene soot from carbon arc under helium before and after annealing)

IT Capillary tubes and channels

(**nanotubes**, structure and properties of fullerene soot from carbon arc under helium before and after annealing)

IT 7782-44-7, Oxygen, processes

RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(effect of oxygen exposure on **ESR** of fullerene soot)

L30 ANSWER 16 OF 16 HCA COPYRIGHT 2003 ACS on STN

124:74625 Physico-chemical studies on **nanotubes** and their

encapsulated compounds. Terrones, M.; Hare, J. P.; Hsu, K.; Kroto, H. W.; Lappas, A.; Maser, W. K.; Pierik, A. J.; Prassides, K.; Taylor, R.; Walton, D. R. M. (Sch. Chem. and Mol. Sci., Univ. Sussex, Brighton, BN1 9QJ, UK). Proceedings - Electrochemical Society, 95-10(Proceedings of the Symposium on Recent Advances in the Chemistry and Physics of Fullerenes

- and Related Materials, 1995), 599-620 (English) **1995**. CODEN: PESODO. ISSN: 0161-6374. Publisher: Electrochemical Society.
- AB Carbon **nanotubes** promise to have important applications in material sciences, nano-engineering and nanoscale electronics. X-ray and HRTEM studies show that these tubular structures have varying morphologies and characteristics, depending on **prodn.** methods. The carrier gas pressure and current applied appear to be important factors in the arc discharge method for changing the amt. of **nanotubes**, nanoparticles, amorphous carbon, and graphitic sheets present in these structures. Variations in pressure and/or current may also influence the av. dimensions of the **nanotubes** and therefore further attempts in the direction of a controlled **prodn.** of **nanotubes** with specific properties have yet to be achieved. Polyhedral carbon particles and carbon **nanotubes** contg. tantalum carbide and molybdenum carbide crystals can be **generated** by inserting the resp. metals into the anode during **prodn.** in the arc-discharge expt. HRTEM images revealed that TaC carbide micro-crystals are present inside both nanoparticles and **nanotubes**, while MoC appears mainly to be present inside polyhedral particles. **ESR**, **SQUID** and cond. measurements indicate that the electronic and magnetic properties of these carbide crystals deposited at the cathode differ from the nonencapsulated ones. These observations promise to open up a new area of materials whose behavior is modified by microencapsulation.
- CC 78-3 (Inorganic Chemicals and Reactions).
Section cross-reference(s): 76, 77
- ST carbon **nanotube prepn** metal carbide encapsulation;
tantalum carbide encapsulation carbon nanoparticle **nanotube**;
molybdenum carbide encapsulation carbon; elec cond carbon encapsulated metal carbide
- IT Electric conductivity and conduction
Electron spin resonance
Magnetic susceptibility
(carbon **nanotube** or nanoparticle encapsulated tantalum and molybdenum carbide)
- IT 12011-97-1P, Molybdenum carbide (MoC) 12070-06-3P, Tantalum carbide
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(carbon encapsulated; **prepn.** of carbon **nanotubes**
and electronic and magnetic properties of carbon encapsulated tantalum and molybdenum carbide)
- IT 7440-44-0P, Carbon, **preparation**
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)
(tantalum and molybdenum carbide encapsulating; **prepn.** of carbon **nanotubes** and electronic and magnetic properties of carbon encapsulated tantalum and molybdenum carbide)

=> file japio, wpix

FILE 'JAPIO' ENTERED AT 14:11:11 ON 19 AUG 2003
COPYRIGHT (C) 2003 Japanese Patent Office (JPO)- JAPIO

FILE 'WPIX' ENTERED AT 14:11:11 ON 19 AUG 2003
COPYRIGHT (C) 2003 THOMSON DERWENT

=> d L47 1-16 ti

L47 ANSWER 1 OF 16 JAPIO (C) 2003 JPO on STN
TI METHOD FOR PRODUCING CARBON **NANOTUBE**

L47 ANSWER 2 OF 16 JAPIO (C) 2003 JPO on STN
TI CARBON **NANOTUBE** THIN FILM DEPOSITION **ECR** PLASMA
CVD SYSTEM USING SLOT ANTENNA AND METHOD FOR DEPOSITING THE SAME
THIN FILM

L47 ANSWER 3 OF 16 JAPIO (C) 2003 JPO on STN
TI PLASMA ENHANCED **CVD** SYSTEM FOR LARGE-DIAMETER CARBON
NANOTUBE THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE
THIN FILM

L47 ANSWER 4 OF 16 JAPIO (C) 2003 JPO on STN
TI **ECR** PLASMA ENHANCED **CVD** SYSTEM FOR CARBON
NANOTUBE THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE
THIN FILM

L47 ANSWER 5 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Method of forming carbon **nanotubes** for electrochemical
capacitors, involves forming **nanotube** by plasma enhanced
chemical vapor deposition using carbon
containing gas plasma.

L47 ANSWER 6 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Method of forming carbon **nanotubes** e.g. for fuel cells, involves
heating coiled filament provided with substrate with catalytic coating,
and pyrolyzing reactant gas to deposit carbon **nanotubes**.

L47 ANSWER 7 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Carbon **nano tube** manufacturing method involves
applying **electron cyclotron resonance** plasma
having carbon content on substrate maintained at preset temperature so as
to form carbon **nano tube**.

L47 ANSWER 8 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **Production** of carbon **nanotube** tip for nano-tweezers
involves exposing tip assembly bearing metallic catalytic material to
gaseous atmosphere comprising carbon containing gas.

L47 ANSWER 9 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Preparation of single wall carbon **nanotubes** by deposition using
electronic resonance plasma (**ECR**) produced within a magnetically
confined chamber.

L47 ANSWER 10 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Field emitter for integrated circuit board of electron beam lithographic
stepper, includes carbon containing tip grown from bottom of dielectric
well using catalyst.

L47 ANSWER 11 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **ECR** plasma device for forming carbon **nano tube**
thin film used as flat surface display, comprises slot antenna at
downstream side of micro-wave generation system to introduce micro-wave
into film forming chamber.

L47 ANSWER 12 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI **Fabrication** of triode-structure carbon **nanotube** field

emitter array involves forming non-reactive layer for preventing carbon **nanotubes** from growing on catalyst layer outside a micro-cavity.

- L47 ANSWER 13 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Apparatus used for separating fluid mixture, e.g. by permeation, pervaporation, filtration, drying or sterilization or as membrane **reactor**, has porous part in contact with polymer, carbon **fiber**, metal or ceramic separating layer.
- L47 ANSWER 14 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Carbon **nano tube** thin film formation apparatus for manufacture of field emission display device has microwave introductory pipe having conical trapezium shape inserted in the film forming chamber.
- L47 ANSWER 15 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Thin film formation method for carbon **nano tube**, involves introducing **microwaves** into film forming **chamber** through quartz upper cover.
- L47 ANSWER 16 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
TI Plasma deposition at **cyclotron resonance**, of **web** of carbon **nanofibers** or **nanotubes** on non-catalytic substrate, forming large grid or filter structures using magnetic mirror under lower pressures.

=> d L47-1-12, 14-16 all

- L47 ANSWER 1 OF 16 JAPIO (C) 2003 JPO on STN
AN 2002-069643 JAPIO
TI METHOD FOR PRODUCING CARBON **NANOTUBE**
IN HOSHI FUMIYUKI; ISHIKURA TAKEFUMI; YUMURA MORIO; FUJIWARA SHUZO; KOGA YOSHINORI
PA NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL & TECHNOLOGY
TOKYO GAS CO LTD
PI JP 2002069643 A **20020308** Heisei
AI JP 2000-259692 (JP2000259692 Heisei) (20000829
PRAI JP 2000-259692 20000829
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2002
IC ICM C23C016-26
ICS B82B003-00; C01B031-02; C23C016-511
ICA H05H001-46
AB PROBLEM TO BE SOLVED: To provide a method for efficiently producing a high quality carbon **nanotube** at a low temperature of about 500-850°C under low pressure of 10^{-4} - 10^{-1} Pa without applying any electrical field.
SOLUTION: This method for producing a carbon **nanotube** comprises introducing a gaseous carbon-containing material into a plasma generating chamber in which inside pressure is held at a level of 10^{-4} - 10^{-1} Pa, a microwave is introduced, and further, a magnetic field is applied to the microwave, generating a electronic **cyclotron resonance** plasma of the carbon-containing material, bringing the plasma into contact with a substrate which is held at a temperature of 500-850°C, and depositing the carbon **nanotube** on the substrate in the vertical direction.
COPYRIGHT: (C)2002,JPO

- L47 ANSWER 2 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-295047 JAPIO

TI CARBON **NANOTUBE** THIN FILM DEPOSITION **ECR** PLASMA
CVD SYSTEM USING SLOT ANTENNA AND METHOD FOR DEPOSITING THE SAME
THIN FILM

IN AGAWA YOSHIKI; YAMAGUCHI KOICHI
PA ULVAC JAPAN LTD
PI JP 2001295047 A 20011026 Heisei
AI JP 2000-108319 (JP2000108319 Heisei) 20000410
PRAI JP 2000-108319 20000410
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS B01J019-12; C01B031-02; C23C016-511

AB PROBLEM TO BE SOLVED: To provide a carbon **nanotube** thin film
deposition **ECR** plasma CVD system using a slot antenna
which requires little labor, has high capacity of **producing** a
carbon **nanotube**, low electric power consumption, and low
production cost and to provide a method for depositing the same
thin film.
SOLUTION: In an **ECR** plasma CVD system, at least one
slot antenna is disposed on the downstream side of a **microwave**
generating system, and **microwaves** are introduced from the slot
antenna into a film deposition **chamber**. By using this system,
mixed **ECR** plasma of a carbon-containing gas and gaseous hydrogen
is generated, and a carbon **nanotube** thin film is deposited
uniformly on a substrate in the direction vertical to the substrate.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 3 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-192830 JAPIO

TI PLASMA ENHANCED CVD SYSTEM FOR LARGE-DIAMETER CARBON
NANOTUBE THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE
THIN FILM

IN AGAWA YOSHIKI; TAKAHASHI SHOJIRO; YAMAMOTO YOSHIHIRO; YAMAGUCHI KOICHI;
HIRAKAWA MASAOKI; MURAKAMI HIROHIKO
PA ULVAC JAPAN LTD
PI JP 2001192830 A 20010717 Heisei
AI JP 2000-300 (JP2000000300 Heisei) 20000105
PRAI JP 2000-300 20000105
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS C01B031-02; C23C016-511

AB PROBLEM TO BE SOLVED: To provide a CVD system for large-diameter
carbon **nanotube** thin film deposition, requiring no much labor
having high **production** capacity of carbon **nanotube** and
low electric power consumption and reduced in manufacturing cost, and a
method of deposition for the thin film.
SOLUTION: In the CVD system for carbon **nanotube** thin
film deposition by means of **microwave** plasma enhanced
chemical vapor deposition, a plurality of
microwave generation systems are arranged in a row and the
cavities of the systems are arranged right above the upper lid of
the deposition **chamber**. A plurality of slits are provided to the
bottoms of the **cavities** of the **microwave** generation
systems and the **microwave** is passed through these slit and
introduced into the deposition **chamber** via the quartz upper lid
right under the **cavities**. The carbon **nanotube** thin
film can be deposited by using this system.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 4 OF 16 JAPIO (C) 2003 JPO on STN
AN 2001-192829 JAPIO

TI **ECR-PLASMA ENHANCED CVD SYSTEM FOR CARBON NANOTUBE THIN FILM DEPOSITION, AND METHOD OF DEPOSITION FOR THE THIN FILM**

IN AGAWA YOSHIKI
PA ULVAC JAPAN LTD
PI JP 2001192829 A (20010717-Heisei
AI JP 2000-299 (JP2000000299 Heisei) 20000105
PRAI JP 2000-299 20000105
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 2001
IC ICM C23C016-26
ICS C01B031-02

AB PROBLEM TO BE SOLVED: To provide a timesaving **CVD** system for carbon **nanotube** thin film deposition, requiring no much labor, having high **production** capacity of carbon **nanotube** and low electric power consumption and reduced in manufacturing cost, and a method of deposition for the thin film.
SOLUTION: In the **CVD** system for carbon **nanotube** thin film deposition by means of **microwave ECR** plasma enhanced **chemical vapor deposition**, the end part of a **microwave** introducing tube of **microwave** generation systems is provided inside a deposition **chamber**. The end part has a hornlike truncated cone shape widening toward the end, and a quartz partition member is provided to the **microwave** introducing tube, in its connecting part with the deposition **chamber** or in its vicinity. The carbon **nanotube** thin film is deposited by using this system.
COPYRIGHT: (C)2001,JPO

L47 ANSWER 5 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2003-300477 [29] WPIX
DNN N2003-239141 DNC C2003-078177
TI Method of forming carbon **nanotubes** for electrochemical capacitors, involves forming **nanotube** by plasma enhanced **chemical vapor deposition** using carbon containing gas plasma.
DC A35 E36 F06 J04 L02 L03 U11 U12 V01 V05 V06 W02
IN BOSKOVIC, B O; HAQ, S; SILVA, P S R
PA (UYSU-N) UNIV SURREY
CYC 100
PI WO 2003011755 A1 20030213 (200329)* EN 50p C01B031-02
RW: AT BE BG CH CY CZ DE DK EA EE ES FI FR GB GH GM GR IE IT KE LS LU
MC MW MZ NL OA PT SD SE SK SL SZ TR TZ UG ZM ZW
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT
RO RU SD SE SG SI SK SL TJ TM TN TR TT TZ UA UG US UZ VN YU ZA ZM
ZW

ADT WO 2003011755 A1 WO 2002-GB3438 20020726
PRAI GB 2001-18341 20010727; GB 2001-18276 20010727; GB 2001-18279
20010727
IC ICM C01B031-02
AB WO2003011755 A UPAB: 20030505
NOVELTY - The carbon **nanotubes** (9) are formed by plasma enhanced **chemical vapor deposition** using a carbon containing gas plasma. The **nanotubes** are not formed on substrate with temperature of 300 deg. C or more.
DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for the following:
(1) Carbon **nanotube** comprising Y- or H-shaped junction; and
(2) Rope of carbon **nanotubes**.

USE - For electrochemical capacitors, nanoelectronics, electronic and photonic device applications, field emission devices, polymer composite **fabrication**, micro electro-mechanical systems, **microwave** resonators, structural materials and electronic semiconductor materials.

ADVANTAGE - **Nanotubes** with desired shape are obtained with high inherent strength.

DESCRIPTION OF DRAWING(S) - The figure shows illustration of a plasma **chamber** for forming and growing carbon **nanotubes**.

Vacuum **chamber** 1

Earthed electrode 6

Substrate 7

Carbon **nanotube** 9

Dwg.1/9

FS CPI EPI

FA AB; GI; DCN

MC CPI: A11-C04B2; A12-E01; E05-U02; E11-N; F03-E01; F04-E; J04-E01;
L02-H04B; L03-B01; L03-D04D; L03-G05D; L04-E; N02-A01; N02-B01;
N02-C01; N04-A
EPI: U11-C01J6; U11-C18B9; U12-B03D; U12-B03F1; U12-B03F2; U12-E01B2;
V01-B01C; V05-F05C1A; V05-F05E5; V05-F08D1; V05-L01A3A; V06-K07A;
V06-M06G; W02-A03A

L47 ANSWER 6 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2003-298656 [29] WPIX

DNN N2003-237495 DNC C2003-077710

TI Method of forming carbon **nanotubes** e.g. for fuel cells, involves heating coiled filament provided with substrate with catalytic coating, and pyrolyzing reactant gas to deposit carbon **nanotubes**.

DC E36 H06 J01 J04 L02 L03 U12 X22

IN JAYATISSA, A H

PA (JAYA-I) JAYATISSA A H

CYC 1

PI US 2002150684 A1 20021017 (200329)* 5p C23C016-00

ADT US 2002150684 A1 US 2001-835757 20010416

PRAI US 2001-835757 20010416

IC ICM C23C016-00

ICS C23C014-00

AB US2002150684 A UPAB: 20030505

NOVELTY - A coiled filament (4) provided with a substrate (7) with catalytic coating (8), is placed in a **chemical vapor deposition (CVD) chamber** (1). Air present in the **chamber** is evacuated and the filament is heated and a bias voltage is applied between the filament and substrate. A reactant gas is introduced into the **chamber** and pyrolyzed, to deposit carbon **nanotubes** on the substrate.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is included for apparatus for forming carbon **nanotubes** which has a **CVD chamber**, inlet (2) for reactant gas, substrate holder (6) and heater for pyrolyzing the reactant gas. The heater comprises a coiled filament and the holder is electrically biased to the coiled filament.

USE - For forming carbon **nanotubes** for use in fuel cells, emission devices, catalysts, filtration and purification, and sensors and microelectro-mechanical manufacturing systems technology.

ADVANTAGE - The method forms densely-packed carbon **nanotubes** by a batch process. The carbon **nanotubes** are formed in a high-density, close-packed configuration to enable large-scale **production**. The carbon **nanotubes** are densely-packed and can be easily separated from the substrate without damage.

DESCRIPTION OF DRAWING(S) - The figure shows a schematic representation of an apparatus used for forming carbon **nanotubes**

on a single substrate.

chemical vapor deposition

chamber 1

gas inlet 2

coiled filament 4

substrate holder 6

substrate 7

catalytic coating 8

Dwg.1/3

FS CPI EPI

FA AB; GI; DCN

MC CPI: E05-U02; H06-A03; J01-D01; J01-E02B; J01-E03C; J01-H; J04-C04;
J04-E04; L02-H04B; L03-E04; N02-A01; N02-B01; N02-C01; N03-D01;
N06-E01; N07-K

EPI: U12-B03F2; X22-F01

L47 ANSWER 7 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2002-503125 [54] WPIX

DNN N2002-398158 DNC C2002-142950

TI Carbon **nano tube** manufacturing method involves
applying **electron cyclotron resonance** plasma
having carbon content on substrate maintained at preset temperature so as
to form carbon **nano tube**.

DC E36 L02 M13 Q68 U11 U12 V05 X14

PA (DOKU-N) DOKURITSU GYOSEI HOJIN SANGYO GIJUTSU SO; (TOLG) TOKYO GAS CO LTD

CYC 1

PI JP 2002069643 A 20020308 (200254)* 5p C23C016-26 <--

ADT JP 2002069643 A JP 2000-259692 20000829

PRAI JP 2000-259692 20000829

IC ICM C23C016-26

ICS B82B003-00; C01B031-02; C23C016-511

ICA H05H001-46

AB JP2002069643 A UPAB: 20020823

NOVELTY - A carbon gas is introduced into a plasma chamber maintained at a
specified pressure, and magnetic field is impressed to microwave waveguide
in the chamber. The **electron cyclotron
resonance** plasma having carbon content is applied on a substrate
maintained at a temperature of 500-850 deg. C so as to form carbon
nano tube on the substrate perpendicularly.

USE - For manufacturing carbon **nano tubes**.

ADVANTAGE - Enables production of a high quality carbon **nano
tube** efficiently, without impressing an electric field.

Dwg.0/0

FS CPI EPI GMPI

FA AB; DCN

MC CPI: E05-U02; E11-N; E31-N03; L02-H04B; M13-E02; M13-E05

EPI: U11-C01J6; U11-C09C; U12-E01B2; V05-F05C3; V05-F05E5; V05-F08D1;
X14-F

L47 ANSWER 8 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2002-479549 [51] WPIX

DNN N2002-378728 DNC C2002-136414

TI **Production** of carbon **nanotube** tip for nano-tweezers
involves exposing tip assembly bearing metallic catalytic material to
gaseous atmosphere comprising carbon containing gas.

DC B04 E36 J04 S02 S03 V05

IN CHEUNG, C L; HAFNER, J H; KIM, P; LIEBER, C M

PA (HARD) HARVARD COLLEGE; (CHEU-I) CHEUNG C L; (HAFN-I) HAFNER J H; (KIMP-I)
KIM P; (LIEB-I) LIEBER C M

CYC 97

PI WO 2002026624 A1 20020404 (200251)* EN 46p C01B031-02
RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ
NL OA PT SD SE SL SZ TR TZ UG ZW
W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PH PL PT RO
RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW
AU 2001094876 A 20020408 (200252) C01B031-02
US 2002122766 A1 20020905 (200260) D01F009-12
ADT WO 2002026624 A1 WO 2001-US30445 20010928; AU 2001094876 A AU 2001-94876
20010928; US 2002122766 A1 Provisional US 2000-237347P 20000929, US
2001-966812 20010928
FDT AU 2001094876 A Based on WO 200226624
PRAI US 2000-237347P 20000929; US 2001-966812 20010928
IC ICM C01B031-02; D01F009-12
ICS G12B021-08
AB WO 200226624 A UPAB: 20020812
NOVELTY - A carbon **nanotube** tip is **produced** by
applying a metallic catalytic material to a tip assembly, inserting the
tip assembly into a **chemical vapor deposition**
(CVD) **reactor**, and exposing the tip assembly to a
gaseous atmosphere comprising a carbon containing gas for
producing a tip assembly bearing a carbon **nanotube** tip.
USE - The method is used in **producing** carbon
nanotube tip for nano-tweezers (claimed) for **fabricating**
quantum dot and quantum wire structures, as electromechanical sensor for
detecting pressure or viscosity of media by measuring the change of
resonance frequency and Q-factor of the device, as a two-tip scanning
tunneling microscope (STM) or conducting atomic force microscopes (AFM)
probe, or for manipulating and modifying of biological systems such as
structures within a cell.
ADVANTAGE - The carbon **nanotube** tip **produced** by
the invention can function as robust, high resolution probes in AFM
experiments, thus the CVD process can be advantageously repeated
at least 5-6 times without replacing the catalyst.
DESCRIPTION OF DRAWING(S) - The figure shows schematically an AFM
cantilever assembly.
Dwg.1A/15
FS CPI EPI
FA AB; GI; DCN
MC CPI: B05-B02C; B05-C06; B05-U; B12-K04; E11-N; E31-N03; J04-B01; N02-A;
N02-B; N02-C; N02-E01; N02-F; N03-D02; N07-G
EPI: S02-F04; S03-E02F1; S03-E02F3; S03-E06B1; S03-F03A; V05-F01A1B
L47 ANSWER 9 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN
AN 2002-417118 [44] WPIX
DNN N2002-328255 DNC C2002-117694
TI Preparation of single wall carbon **nanotubes** by deposition using
electronic resonance plasma (ECR) produced within a magnetically
confined chamber.
DC E36 L02 L03 Q68 U11 U12 V05 X14
IN DELAUNAY, M; VANNUFEL, C; VANNUFEL, C
PA (COMS) COMMISSARIAT ENERGIE ATOMIQUE
CYC 21
PI WO 2002034669 A1 20020502 (200244)* FR 55p C01B031-02 <--
RW: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR
W: JP US
FR 2815954 A1 20020503 (200244) B82B003-00 <--
ADT WO 2002034669 A1 WO 2001-FR3334 20011026; FR 2815954 A1 FR 2000-13831
20001027

PRAI FR 2000-13831 20001027

IC ICM B82B003-00; C01B031-02

ICS C01B003-00; C23C016-26; C23C016-511; C30B029-66; C30B030-02;
C30B030-04; H05H001-18; H05H001-24

AB WO 200234669 A UPAB: 20020711

NOVELTY - Process for **ECR** plasma deposition of mono-walled carbon **nanotubes** on a substrate free of catalyst by injection of microwave power in a deposition chamber comprising a magnetic mirror confinement system and an **ECR** zone.

DETAILED DESCRIPTION - Process for **ECR** plasma deposition of mono-walled carbon **nanotubes** on a substrate free of catalyst by injection of microwave power in a deposition chamber comprising a magnetic mirror confinement system and an **ECR** zone. The dissociation and ionization of a gas containing carbon is initiated in the center of the chamber at a pressure of 10⁻³ mbar producing species which deposit on the heated substrate. The latter comprises prominence and cavities. INDEPENDENT CLAIMS are included for the apparatus and substrate.

USE - The **nanotubes** have numerous applications, in nanoelectronics, storage of hydrogen for fuel cells, electron emitters for flat screens and uses as semi-conductors.

ADVANTAGE - The invention represents a first successful preparation of single-walled **nanotubes** by **ECR** plasma processes. Contrary to former processes no catalysts is required, and deposition of **nanotubes** is possible at relatively low temperatures on large surface areas.

Dwg.1/7

FS CPI EPI GMPI

FA AB; GI; DCN

MC CPI: E05-U; E11-N; E11-P; L02-H04B; L03-H04D

EPI: U11-C01B; U12-B03F2; V05-F05C1A; V05-F05C3; V05-F05E5; V05-F08D1;
X14-F01

L47 ANSWER 10 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2002-392809 [42] WPIX

DNC C2002-110436

TI Field emitter for integrated circuit board of electron beam lithographic stepper, includes carbon containing tip grown from bottom of dielectric well using catalyst.

DC L03

IN BRITTON, C L; GUILLORN, M A; LOWNDES, D H; MERKULOV, V I; SIMPSON, M L

PA (UTBA-N) UT-BATTELLE LLC; (UNAC) UT BATTELLE LLC

CYC 97

PI US 2002024279 A1 20020228 (200242)* 21p H01J001-02

WO 2002019372 A2 20020307 (200242) EN H01J029-00

RW: AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ
NL OA PT SD SE SL SZ TR TZ UG ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK
DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR
KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU
SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

AU 2001083323 A 20020313 (200249) H01J029-00

EP 1314176 A2 20030528 (200336) EN H01J009-02

R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT
RO SE SI TR

ADT US 2002024279 A1 Provisional US 2000-228713P 20000829, US 2001-810531
20010315; WO 2002019372 A2 WO 2001-US25270 20010809; AU 2001083323 A AU
2001-83323 20010809; EP 1314176 A2 EP 2001-962116 20010809, WO
2001-US25270 20010809

FDT AU 2001083323 A Based on WO 200219372; EP 1314176 A2 Based on WO 200219372

PRAI US 2000-228713P 20000829; US 2001-810531 20010315

IC ICM H01J001-02; H01J009-02; H01J029-00

AB US2002024279 A UPAB: 20020704

NOVELTY - A field emitter has a carbon containing tip having a base located at a bottom of the dielectric well and extending away from the substrate (300). The carbon containing tip is grown from the bottom of the dielectric well using a catalyst that is introduced at the bottom of the dielectric well after the dielectric well is formed.

DETAILED DESCRIPTION - A field emitter comprises a substrate, an electrode structure, and a carbon containing tip. The electrode structure includes a dielectric layer having a dielectric well that is formed in the dielectric layer after the dielectric layer is deposited, and an extractor layer having an extractor aperture. The carbon containing tip has a base located at a bottom of the dielectric well and extending away from the substrate. It is grown from the bottom of the dielectric well using a catalyst that is introduced at the bottom of the dielectric well after the dielectric well is formed.

An INDEPENDENT CLAIM is also included for a method for making a field emitter comprising providing a substrate on a heater plate in a vacuum chamber, providing a carbon source gas and an etchant gas, heating the substrate with the heater plate, and fabricating a carbon containing tip on the substrate with the carbon source gas and the etchant gas using plasma enhanced chemical vapor deposition.

USE - The field emitter is used in integrated circuit board of electron beam lithographic stepper (claimed). It is also useful in flat panel displays, massively parallel digital electrostatic e-beam array lithography, and/or electron microscopy.

ADVANTAGE - The invention provides field emitters that do not need to be lithography defined, are non-metallic, have a high aspect ratio and a high geometrical enhancement factor, a low threshold field strength, and are relatively easy to fabricate. It improves quality and/or reduces costs.

DESCRIPTION OF DRAWING(S) - The figure is a schematic view of an electrode-emitter.

Substrate 300

Multiwall nanotube 360

Dwg.3G/13

FS CPI

FA AB; GI

MC CPI: L03-G05D

L47 ANSWER 11 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2002-309150 [35] WPIX

DNN N2002-242039 DNC C2002-089986

TI ECR plasma device for forming carbon nano tube thin film used as flat surface display, comprises slot antenna at downstream side of micro-wave generation system to introduce micro-wave into film forming chamber.

DC E36 L03 M13 U11 V05 W02

PA (ULVA) ULVAC CORP

CYC 1

PI JP 2001295047 A 20011026 (200235)* 6p C23C016-26 <--

ADT JP 2001295047 A JP 2000-108319 20000410

PRAI JP 2000-108319 20000410

IC ICM C23C016-26

ICS B01J019-12; C01B031-02; C23C016-511

AB JP2001295047 A UPAB: 20020603

NOVELTY - The device comprises a film forming chamber (21), a substrate holder (24) provided inside the chamber, and a gas supply system to supply carbon containing gas and hydrogen gas to chamber. A bias power supply

(27) is connected to substrate holder. A micro-wave generation system (22) generates and introduces micro-wave into chamber via slot antenna (22f) provided to its downstream side, to produce **ECR** plasma.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for formation method of carbon **nano tube** thin film.

USE - For forming carbon **nano tube** thin film used as flat surface display on components that needs an electronic light-emitting element, or used as alternative for electron tube of cathode ray tube (CRT).

ADVANTAGE - The carbon **nano tube** thin film can be formed uniformly and economically without taking much time and effort. Production capacity of the film is high. Consumption of electric power is low.

DESCRIPTION OF DRAWING(S) - The figure shows the top-elevation, side, right-side and sectional views of **electron-cyclotron-resonance (ECR)** plasma chemical vapor deposition (CVD) device.

Film forming chamber 21

Micro-wave generation system 22

Slot antenna 22f

Substrate holder 24

Bias power supply 27

Dwg.2/2

FS CPI EPI

FA AB; GI; DCN

MC CPI: E05-U; E05-U02; L03-H04D; M13-E05

EPI: U11-C01J6; U11-C09C; V05-F04L; V05-F05C1A; V05-F05C3; V05-F05E3;
W02-B02C

L47 ANSWER 12 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2002-197219 [26] WPIX

DNN N2002-149788 DNC C2002-061139

TI **Fabrication** of triode-structure carbon **nanotube** field emitter array involves forming non-reactive layer for preventing carbon **nanotubes** from growing on catalyst layer outside a micro-cavity.

DC L03 U11 U12 V05

IN CHOI, Y; KIM, J; LEE, H; LEE, N; CHOI, Y S; KIM, J M; LEE, H U; LEE, N S

PA (SMSU) SAMSUNG SDI CO LTD; (SMSU) SAMSUNG DENKAN KK; (CHOI-I) CHOI Y;
(KIMJ-I) KIM J; (LEE-H-I) LEE H; (LEEN-I) LEE N

CYC 29

PI EP 1115135 A1 20010711 (200226)* EN 15p H01J009-02

R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT
RO SE SI TR

JP 2001236879 A 20010831 (200226) 9p H01J009-02

KR 2001068652 A 20010723 (200226) H01J009-02

US 6339281 B2 20020115 (200226) H01J001-304

US 2001007783 A1 20010712 (200226) H01L021-00

ADT EP 1115135 A1 EP 2001-300082 20010105; JP 2001236879 A JP 2001-1103

20010109; KR 2001068652 A KR 2000-668 20000107; US 6339281 B2 US

2001-754148 20010105; US 2001007783 A1 US 2001-754148 20010105

PRAI KR 2000-668 20000107

IC ICM H01J001-304; H01J009-02; H01L021-00

ICS C01B031-02; C23C014-06; H01L021-84

AB EP 1115135 A UPAB: 20020424

NOVELTY - A triode-structure **nanotube** field emitter array is **fabricated** by forming a separation layer; forming a catalyst layer on the separation layer and the cathode electrode within the micro-cavity; forming a non-reactive layer for preventing carbon **nanotubes** from growing on the catalyst layer outside the micro-

cavity; and growing carbon **nanotubes** on the catalyst layer within the micro-**cavity**.

DETAILED DESCRIPTION - **Fabrication** of triode-structure carbon **nanotube** field emitter array involves

- (a) forming a separation layer on a gate electrode using slant deposition in a structure with a cathode electrode and microcavity;
- (b) forming a catalyst layer (9) on the separation layer and the cathode electrode within the micro-**cavity**;
- (c) performing slant deposition on the catalyst layer to form a non-reactive layer (77) for preventing carbon **nanotubes** (10) from growing on the catalyst layer outside the micro-**cavity**;
- (d) growing carbon **nanotubes** on the catalyst layer within the micro-**cavity**; and removing the separation layer.

The structure also includes a gate insulation layer, and gate electrode sequentially formed on a cathode glass substrate, and a gate opening formed on the gate electrode. The cathode electrode is formed on a cathode glass substrate. The micro-**cavity**, which corresponds to the gate opening, is formed in the gate insulation layer.

USE - For **fabricating** triode field emitter array.

ADVANTAGE - The **fabrication** yield is increased, and the **fabrication** cost is decreased.

DESCRIPTION OF DRAWING(S) - The figure shows a sectional view of forming **nanotubes** on the catalyst layer.

Catalyst layer 9

Carbon **nanotubes** 10

Non-reactive layer 77

Dwg.3B/9

FS CPI EPI

FA AB; GI

MC CPI: L03-C02A; L03-G05

EPI: U11-C01J6; U11-C18B2; U12-D01B2; U12-E01B2; U12-Q; V05-L01A3A; V05-L05B5

L47 ANSWER 14 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2001-641626 [74] WPIX

DNN N2001-479877 DNC C2001-189937

TI Carbon **nano tube** thin film formation apparatus for manufacture of field emission display device has microwave introductory pipe having conical trapezium shape inserted in the film forming chamber.

DC E36 L03 V05 X14

PA (ULVA) ULVAC CORP.

CYC 1

PI JP 2001192829 A (20010717 (200174)* 6p C23C016-26 <--

ADT JP 2001192829 A JP 2000-299 20000105

PRAI JP 2000-299 20000105

IC ICM C23C016-26

ICS C01B031-02

AB JP2001192829 A UPAB: 20011217

NOVELTY - Electric power supply (27) is connected to a substrate holder (24) inside film forming chamber (21). Gas cylinders (36a,36b) supply gas containing carbon and hydrogen gas inside the chamber. Microwave generation system (22) generates ECR plasma inside the chamber. Microwave generation system has microwave introductory pipe (22g) having leading end having conical trapezium shape inserted in the chamber.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for a thin film formation method.

USE - For manufacture of field emission display device.

ADVANTAGE - Enables to form thin film uniformly on the substrate without much time and effort, improves production capacity of carbon **nano tube** and reduces power consumption and

manufacturing cost.

DESCRIPTION OF DRAWING(S) - The figure shows the block diagram of carbon **nano tube** thin film formation apparatus.

(Drawing includes non-English language text).

Inside film forming chamber 21
Microwave generation system 22
Microwave introductory pipe 22g
Substrate holder 24
Electric power supply 27
Gas cylinders 36a,36b

Dwg.2/2

FS CPI EPI

FA AB; GI; DCN

MC CPI: E05-U; L03-C02

EPI: V05-F05C1A; V05-F05C3; V05-F08D1; V05-L01A3A; V05-L05A1; X14-F

L47 ANSWER 15 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2001-629274 [73] WPIX

DNN N2001-469294 DNC C2001-187682

TI Thin film formation method for carbon **nano tube**, involves introducing **microwaves** into film forming **chamber** through quartz upper cover.

DC E36 L03 V05 X14

PA (ULVA) ULVAC CORP

CYC 1

PI JP 2001192830 A 20010717 (200173)* 6p C23C016-26

ADT JP 2001192830 A JP 2000-300 20000105

PRAI JP 2000-300 20000105

IC ICM C23C016-26

ICS C01B031-02; C23C016-511

AB JP2001192830 A UPAB: 20011211

NOVELTY - Two **microwave** generators (22,22') are arranged oppositely with **cavities** (22f) of each generator provided with slits (38). The **cavity** of each generator is arranged over an upper cover (23) made of quartz. **Microwaves** are guided along the slits and are introduced into film forming **chamber** through the upper cover.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is also included for thin film forming apparatus.

USE - For forming thin film for carbon **nano tube** used in flat emission displays.

ADVANTAGE - The carbon **nano tube** is manufactured in short time with less cost due to less electric power consumption, hence **productivity** is high.

DESCRIPTION OF DRAWING(S) - The figure shows the sectional view of thin film formation plasma **CVD** apparatus. (Drawing includes non-English language text).

Microwave generators 22,22'

Cavities 22f

Upper cover 23

Slits 38

Dwg.2/2

FS CPI EPI

FA AB; GI; DCN

MC CPI: E05-U02; L04-D01

EPI: V05-F04L; V05-F05C1A; V05-F08D1; V05-L01A3; V05-L01A3A; V05-L05D1; X14-F

L47 ANSWER 16 OF 16 WPIX COPYRIGHT 2003 THOMSON DERWENT on STN

AN 2001-161377 [17] WPIX

DNN N2001-117681 DNC C2001-048304

TI Plasma deposition at **cyclotron resonance**, of **web** of carbon **nanofibers** or **nanotubes** on non-catalytic substrate, forming large grid or filter structures using magnetic mirror under lower pressures.

DC L02 L03 Q68 U11 U12 V05 X14

IN DELAUNAY, M; SEMERIA, M N; SEMERIA, M

PA (COMS) COMMISSARIAT ENERGIE ATOMIQUE

CYC 27

PI FR 2795906 A1 20010105 (200117)* 45p H05H001-46 <--
 WO 2001003158 A1 20010111 (200117) FR H01J037-32 <--
 RW: AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE
 W: JP US

EP 1192637 A1 20020403 (200230) FR H01J037-32 <--
 R: AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT
 RO SE SI

JP 2003504512 W 20030204 (200320) 35p C23C016-26 <--

ADT FR 2795906 A1 FR 1999-8473 19990701; WO 2001003158 A1 WO 2000-FR1827 20000629; EP 1192637 A1 EP 2000-949577 20000629, WO 2000-FR1827 20000629; JP 2003504512 W WO 2000-FR1827 20000629, JP 2001-508475 20000629

FDT EP 1192637 A1 Based on WO 200103158; JP 2003504512 W Based on WO 200103158

PRAI FR 1999-8473 19990701

IC ICM C23C016-26; H01J037-32; H05H001-46

ICS B82B003-00; C01B031-02; H01J009-12; H01J029-02; H01J031-12

AB FR 2795906 A UPAB: 20010328

NOVELTY - **Microwave** power is applied in deposition **chamber**. The **chamber** includes a highly de-stabilized magnetic mirror structure and at least one zone of **electron cyclotron resonance** facing the substrate. At a pressure less than 10^{-4} mbar, ionization and/or dissociation of a gas containing carbon is caused in the magnetic mirror at the center of the deposition **chamber**, to **produce** species for deposition onto the surface, which is heated.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for equipment **producing** the deposit, the layer so **produced**, a non-catalytic spidery **cloth**, a corresponding multilayer filter, optionally with substrate, a filter where the layer(s) are spread onto a rigid grid, an electron acceleration nanogrid and a flat screen of large dimensions, including the grid.

USE - To **produce** a **web** of carbon **nanofibers** or **nanotubes** on non-catalytic substrate

ADVANTAGE - The process deposits over very large areas, e.g. 1 m². Plasma is confined by the magnetic structure. The **cyclotron** electronic **resonance** (CER) zone is located actually inside the deposition **chamber**, contrasting with prior art; there is no separation between reaction **chamber** and the deposition **chamber**. Operation is at particularly low pressure, generally below 10^{-4} . These conditions strongly dissociate organic molecules (e.g. methane is cited) to obtain layers forming the **nanofiber** or **nanotube webs** or interconnected networks in the spidery **cloth** structure. The plasma itself remains stationery and stable. The process falls between the two extremes of physical vapor phase **deposition** (PVD) and **chemical vapor phase deposition** (CVD). Decomposition equations for methane, under **chamber** conditions are provided. Further discussion and quantification of conditions is included, including details of the magnetic field strengths and configurations. Practical examples are provided. Twenty references are complemented by a tabulation of prior art experimental conditions, some relating to diamond structures.

Dwg.0/5

FS CPI EPI GMPI
FA AB
MC CPI: L02-H04A; L03-H04D
EPI: U11-C09C; U12-B03X; V05-F05C1A; V05-F05C3; V05-F08D1; X14-F

=> file compendex, inspec

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L62 ANSWER 1 OF 12 COMPENDEX COPYRIGHT 2003 EEI on STN

AN 1999(17):2981 COMPENDEX

TI **Synthesis** of carbon **nanotubes** by arc discharge in CF4 gas atmosphere.

AU Yokomichi, Haruo (Toyama Prefectural Univ, Toyama, Jpn); Matoba, Masaaki; Sakima, Hiroyuki; Ichihara, Masaki; Sakai, Fumiko

SO Japanese Journal of Applied Physics, Part 1: Regular Papers & Short Notes & Review Papers v 37 n 12A Dec 1998.p 6492-6496

CODEN: JAPNDE

PY 1998

DT Journal

TC Experimental

LA English

AB Carbon **nanotubes** were **synthesized** by arc discharge in a CF4 gas atmosphere involving fluorine atoms, which are able to terminate carbon bonding, while no fullerenes were **synthesized** in a CF4 gas atmosphere. The morphology of these **nanotubes** was investigated by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Based on these results, the **synthesized** conditions in CF4 gas were compared with those in other gases, i.e., in CH4, H2, He and Ar gases. In addition, **electron spin resonance** (ESR) measurements were performed in order to obtain information about the electronic properties of these **nanotubes**. (Author abstract) 19 Refs.

CC 933.1 Crystalline Solids; 804 Chemical Products Generally; 802.2 Chemical Reactions; 804.1 Organic Components; 701.1 Electricity: Basic Concepts and Phenomena; 801.4 Physical Chemistry

CT ***Nanotubes**; Scanning electron microscopy; Fluorine compounds; Electric discharges; Chemical bonds; Morphology; Electronic properties; Transmission electron microscopy; Fullerenes; **Synthesis** (chemical)

ST Carbon tetrafluoride

ET C*F; CF4; C cp; cp; F cp; C*H; CH4; H cp; H2; He; Ar

L62 ANSWER 2 OF 12 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 1999(4):4460 COMPENDEX
TI ESR of purified carbon **nanotubes** produced under
different helium pressures.
AU Wong, S.P. (Chinese Univ of Hong Kong, Hong Kong); Zhang, Haiyan; Ke,
Ning; Peng, Shaoqi
MT Proceedings of the 1997 MRS Fall Symposium.
MO MRS
ML Boston, MA, USA
MD 02 Dec 1997-04 Dec 1997
SO Recent Advances in Catalytic Materials Materials Research Society
Symposium - Proceedings v 497 1998.MRS, Warrendale, PA, USA.p 151-156
CODEN: MRSPDH ISSN: 0272-9172
PY 1998
MN 48274
DT Conference Article
TC Experimental
LA English
AB Carbon **nanotubes** were prepared by the dc arc-discharge method
under a controlled helium pressure ranging from 10 to 80 kPa and
subsequently purified by oxidation in air. The purified carbon
nanotubes were observed by transmission electron microscopy. The
room temperature **electron spin resonance**
(ESR) spectra of the purified **nanotubes** were measured. The
variations in the ESR line shape, g-value, linewidth and relative
spin density of the purified **nanotubes** on helium
pressure were studied and discussed. (Author abstract) 14 Refs.
CC 804 Chemical Products Generally; 933.1 Crystalline Solids; 801.4 Physical
Chemistry; 802.2 Chemical Reactions
CT *Carbon; Pressure effects; Helium; **Electron spin**
resonance spectroscopy; Oxidation; Transmission electron
microscopy; Purification; **Nanotubes**
ST Helium pressure; Arc discharge method

L62 ANSWER 3 OF 12 INSPEC (C) 2003 IEE on STN
AN 2000:6583274 INSPEC DN A2000-12-6148-001
TI Physical properties of carbon **nanotubes**.
AU Salvétat, J.-P.; Bonard, J.-M.; Bacsá, R.; Stockli, T.; Forro, L. (Dept.
of Phys., Swiss Fed. Inst. of Technol., Lausanne, Switzerland)
SO AIP Conference Proceedings (1998) no.442, p.467-80. 25 refs.
Published by: AIP
Price: CCCC 0094-243X/98/\$15.00
CODEN: APCPCS ISSN: 0094-243X
SICI: 0094-243X(1998)442L:467:PPCN;1-M
Conference: Electronic Properties of Novel Materials - Progress in
Molecular Nanostructures. XI International Winterschool. Kirchberg Tyrol,
Austria, March 1998
DT Conference Article; Journal
TC Experimental
CY United States
LA English
AB Carbon **nanotube** science is a new exciting subject for all the
carbon community. We now have in hand 1D graphite prototypes opening a new
field for basic research and increasing the technological potential of
traditional carbon **fibers**. In addition to many open fundamental
questions, one of the main difficulties resides on the technological side,
since large scale **synthesis**, high purity samples, and
manipulation at the nanoscale are not yet fully developed. In this paper,
we present recent development on different **nanotube** aspects:

- preparation and purification, electronic transport properties, **electron spin resonance**, mechanical behaviour of individual **nanotubes**, and field-emission.
- CC A6148 Structure of fullerenes and fullerene-related materials; A7125X Electronic structure of fullerenes and fullerene-related materials; intercalation compounds; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A7630 Electron paramagnetic resonance and relaxation (condensed matter); A7970 Field emission and field ionization
- CT CARBON **NANOTUBES**; ELECTRON FIELD EMISSION; MATERIALS PREPARATION; PARAMAGNETIC RESONANCE
- ST **carbon nanotubes**; 1D graphite prototypes; **large scale synthesis**; high purity samples; electronic transport properties; **electron spin resonance**; mechanical behaviour; field-emission; C
- CHI C el
- ET D; C
- L62 ANSWER 4 OF 12 INSPEC (C) 2003 IEE on STN
- AN 1999:6205828 INSPEC DN A1999-09-8120V-001
- TI Morphology and electronic properties of carbon **nanotubes synthesized** by arc discharge in CF₄ gas.
- AU Yokomichi, H.; Sakima, H.; Matoba, R. (Dept. of Electron. & Inf. Eng., Toyama Prefectural Univ., Japan); Ichihara, M.; Sakai, F.
- SO Superlattices and Microstructures (1999) vol.25, no.1-2, p.487-91. 12 refs.
Published by: Academic Press
Price: CCCC 0749-6036/99/010487+05\$30.00/0
CODEN: SUMIEK ISSN: 0749-6036
SICI: 0749-6036(1999)25:1/2L.487:MEPC;1-S
Conference: 11th International Conference on Superlattices, Microstructures and Microdevices, 1998. Hurgada, Egypt, 27-31 July 1998
- DT Conference Article; Journal
- TC Experimental
- CY United Kingdom
- LA English
- AB The morphology of carbon **nanotubes synthesized** by arc discharge in a CF₄ gas atmosphere was investigated by scanning electron microscopy and transmission electron microscopy. The electronic properties of these **nanotubes** were investigated by **electron spin resonance**. The **synthesis** conditions in CF₄ gas were then compared with those in CH₄, H₂ and He based on these results. Furthermore, the mechanism of tube growth in CF₄ gas was discussed briefly.
- CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A7125X Electronic structure of fullerenes and fullerene-related materials; intercalation compounds; A6150J Crystal morphology and orientation; A5275R Plasma applications in manufacturing and materials processing; A7630L EPR of other ions and impurities
- CT BAND STRUCTURE; CARBON **NANOTUBES**; CRYSTAL MORPHOLOGY; PARAMAGNETIC RESONANCE; PLASMA DEPOSITION; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY
- ST morphology; electronic properties; **carbon nanotubes**; arc discharge; CF₄ gas; scanning electron microscopy; transmission electron microscopy; **electron spin resonance**; **synthesis conditions**; tube growth; C
- CHI C el
- ET C*F; CF₄; C cp; cp; F cp; C*H; CH₄; H cp; H₂; He; C
- L62 ANSWER 5 OF 12 INSPEC (C) 2003 IEE on STN

AN 1999:6137355 INSPEC DN A1999-04-8120V-003
TI **Synthesis** of carbon **nanotubes** by arc discharge in CF₄ gas atmosphere.
AU Yokomichi, H.; Matoba, M.; Sakima, H.; Ichihara, M.; Sakai, F. (Dept. of Electron. & Inf., Toyama Univ., Japan)
SO Japanese Journal of Applied Physics, Part 1 (Regular Papers, Short Notes & Review Papers) (Dec. 1998) vol.37, no.12A, p.6492-6. 19 refs.
Published by: Publication Office, Japanese Journal Appl. Phys
CODEN: JAPNDE ISSN: 0021-4922
SICI: 0021-4922(199812)37:12AL.6492:SCND;1-Z
DT Journal
TC Experimental
CY Japan
LA English
AB Carbon **nanotubes** were **synthesized** by arc discharge in a CF₄ gas atmosphere involving fluorine atoms, which are able to terminate carbon bonding, while no fullerenes were **synthesized** in a CF₄ gas atmosphere. The morphology of these **nanotubes** was investigated by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Based on these results, the **synthesized** conditions in CF₄ gas were compared with those in other gases, i.e., in CH₄, H₂, He and Ar gases. In addition, **electron spin resonance** (ESR) measurements were performed in order to obtain information about the electronic properties of these **nanotubes**.
CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A7125X Electronic structure of fullerenes and fullerene-related materials; intercalation compounds; A7630L EPR of other ions and impurities
CT BONDS (CHEMICAL); CARBON **NANOTUBES**; CRYSTAL MORPHOLOGY; PARAMAGNETIC RESONANCE; PLASMA DEPOSITION; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY
ST **synthesis**; carbon **nanotubes**; arc discharge; CF₄ gas atmosphere; fluorine atoms; carbon bonding; morphology; scanning electron microscopy; SEM; transmission electron microscopy; TEM; H₂; He; Ar; **electron spin resonance**; ESR; electronic properties; C
CHI C el; H₂ el; H el; He el; Ar el
ET C*F; CF₄; C cp; cp; F cp; C*H; CH₄; H cp; H₂; He; Ar; C; H

L62 ANSWER 6 OF 12 INSPEC (C) 2003 IEE on STN
AN 1999:6129576 INSPEC DN A1999-04-8120V-001
TI Well-aligned carbon nitride **nanotubes** synthesized in anodic alumina by **electron cyclotron resonance chemical vapor deposition**.
AU Sung, S.L.; Tsai, S.L.; Tseng, C.H.; Chiang, F.K.; Liu, X.W.; Shih, H.C. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)
SO Applied Physics Letters (11 Jan. 1999) vol.74, no.2, p.197-9. 31 refs.
Doc. No.: S0003-6951(99)03102-2
Published by: AIP
Price: CCCC 0003-6951/99/74(2)/197(3)/\$15.00
CODEN: APPLAB ISSN: 0003-6951
SICI: 0003-6951(19990111)74:2L.197:WACN;1-B
DT Journal
TC Experimental
CY United States
LA English
AB Vertically aligned carbon nitride **nanotubes** with a uniform diameter of about 250 nm have been synthesized on a porous alumina membrane template (50-80 μ m thick) in a microwave excited plasma of C₂H₂

and N₂ using an **electron cyclotron resonance chemical vapor deposition** system. A negative dc bias voltage was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nanochannels of the alumina template. This allowed the physical, and subsequent chemical, absorption of species on the walls of the nanochannels that resulted in the formation of the carbon nitride **nanotubes**. The hollow structure and vertically aligned properties of the **nanotubes** have been clearly verified by field-emission scanning electron microscope images. The absorption band between 1250 and 1750 cm⁻¹ in the Fourier transform infrared spectroscopy spectrum proves that nitrogen atoms have been incorporated into an amorphous network of carbon.

CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6148 Structure of fullerenes and fullerene-related materials; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures); A5275R Plasma applications in manufacturing and materials processing; A8115H Chemical vapour deposition; A7830L Infrared and Raman spectra in disordered solids

CT ALUMINA; ANODISED LAYERS; CARBON COMPOUNDS; CARBON **NANOTUBES**; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; PLASMA CVD; POROUS MATERIALS; SCANNING ELECTRON MICROSCOPY

ST **C-N nanotube synthesis**; anodic Al₂O₃; ECR CVD; **electron cyclotron resonance chemical vapor deposition**; **vertically aligned carbon nitride nanotubes**; porous alumina membrane template; microwave excited plasma; C₂H₂- N₂ plasma; negative dc bias voltage; ionic flux flow; alumina template nanochannels; chemical species absorption; hollow structure; field-emission scanning electron microscope images; Fourier transform infrared spectroscopy spectrum; amorphous C network; acetylene; 250 nm; 1250 to 1750 cm⁻¹; C-N; Al₂O₃; N₂

CHI CN bin, C bin, N bin; Al₂O₃ sur, Al₂ sur, Al sur, O₃ sur, O sur, Al₂O₃ bin, Al₂ bin, Al bin, O₃ bin, O bin; N₂ el, N el

PHP size 2.5E-07 m; wavelength 5.71E-06 to 8.00E-06 m

ET C*H; C₂H₂; C cp; cp; H cp; N₂; C*N; C-N; Al*O; Al₂O₃; Al cp; O cp; C; CN; N cp; Al₂O; Al; O; N

L62 ANSWER 7 OF 12 INSPEC (C) 2003 FIZ KARLSRUHE on STN

AN 1998:5964395 INSPEC DN A9816-6146-013

TI Are boron-doped carbon **nanotubes** metallic?.

AU Yokomichi, H.; Matoba, M. (Dept. of Electron. & Inf., Toyama Prefectural Univ., Kosugi, Japan); Fukuhara, T.; Sakima, H.; Sakai, F.; Maezawa, K.

SO Physica Status Solidi B (1 May 1998) vol.207, no.1, p.R1-2. 4 refs.

Published by: Akademie Verlag

Price: CCCC 0370-1972/98/\$17.50+0.50

CODEN: PSSBBD ISSN: 0370-1972

SICI: 0370-1972(19980501)207:1L.r1:BDCN;1-W

DT Journal

TC Experimental

CY Germany, Federal Republic of

LA English

AB Although boron-doped (B-doped) carbon **nanotubes** and boroncarbonnitrogen (B-C-N) **nanotubes** have been **synthesized**, there are not known investigations of the electronic properties of these **nanotubes**. In this brief report, we investigate the electronic properties of B-doped carbon **nanotubes** using **electron spin resonance** (ESR) and conductance measurements. The morphology of **synthesized nanotubes** is also investigated by scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

- CC A6146 Solid clusters (including fullerenes) and nanoparticles; A6480G Microstructure; A6820 Solid surface structure; A7630P EPR of conduction electrons
- CT BORON; CARBON; CESR; ELECTRICAL CONDUCTIVITY; NANOSTRUCTURED MATERIALS; NITROGEN; SCANNING ELECTRON MICROSCOPY; SURFACE TOPOGRAPHY; TRANSMISSION ELECTRON MICROSCOPY
- ST **carbon nanotubes**; boron doping; **boron-carbon-nitrogen nanotubes**; electronic properties; **electron spin resonance**; CESR; conductance measurements; morphology; SEM; scanning electron microscopy; TEM; transmission electron microscopy; 77 to 290 K; C:B; BCN
- CHI C:B bin, B bin, C bin, B el, C el, B dop; BCN ss, CN ss, B ss, C ss, N ss
- PHP temperature 7.7E+01 to 2.9E+02 K
- ET B; C*B*N; B-C-N; C*B; C:B; B doping; doped materials; C*N; CN; C cp; cp; N cp
- L62 ANSWER 8 OF 12 INSPEC (C) 2003 IEE on STN
- AN 1997:5785389 INSPEC DN A9803-7630P-001
- TI **Electron-spin resonance** and **microwave** resistivity of single-wall carbon **nanotubes**.
- AU Petit, P.; Jouguelet, E. (Inst. Charles Sadron, Strasbourg, France); Fischer, J.E.; Rinzler, A.G.; Smalley, R.E.
- SO Physical Review B (Condensed Matter) (15 Oct. 1997) vol.56, no.15, p.9275-8. 25 refs.
Doc. No.: S0163-1829(97)08440-3
Published by: APS through AIP
Price: CCCC 0163-1829/97/56(15)/9275(4)/\$10.00
CODEN: PRBMDO ISSN: 0163-1829
SICI: 0163-1829(19971015)56:15L.9275:ESRM;1-0
- DT Journal
- TC Experimental
- CY United States
- LA English
- AB We compare the thermal variations of ESR, dc and **microwave** resistivity of unoriented bulk single wall carbon **nanotube** samples. We conclude that the "metallic" high-T behavior ($d\rho/dT > 0$) is an intrinsic property of the bulk material, and that the system remains metallic even at low temperature where $d\rho/dT < 0$. The **spin** susceptibility is also independent of T, and a long mean free path implies transport predominantly along the tube axes in bulk material.
- CC A7630P EPR of conduction electrons; A6146 Solid clusters (including fullerenes) and nanoparticles; A7325 Surface conductivity and carrier phenomena
- CT CARBON; ELECTRICAL RESISTIVITY; **MICROWAVE** MEASUREMENT; NANOSTRUCTURED MATERIALS; PARAMAGNETIC RESONANCE; SURFACE CONDUCTIVITY
- ST **electron-spin resonance**; **microwave resistivity**; **single-wall C nanotubes**; thermal variations; **spin susceptibility**; C
- CHI C sur, C el
- ET T; C
- L62 ANSWER 9 OF 12 INSPEC (C) 2003 IEE on STN
- AN 1997:5784594 INSPEC DN A9803-6146-003
- TI Experimental verification of the dominant influence of extended carbon networks on the structural, electrical and magnetic properties of a common soot.
- AU Dunne, L.J.; Nolan, P.F. (Chem. Eng. Res. Centre, South Bank Univ., London, UK); Munn, J.; Terrones, M.; Jones, T.; Kathirgamanathan, P.; Fernandez, J.; Hudson, A.D.
- SO Journal of Physics: Condensed Matter (1 Dec. 1997) vol.9, no.48, p.10661-73. 30 refs.

Doc. No.: S0953-8984(97)85512-9
Published by: IOP Publishing
Price: CCCC 0953-8984/97/4810661+13\$19.50
CODEN: JCOMEL ISSN: 0953-8984
SICI: 0953-8984(19971201)9:48L:10661:EVDI;1-H

DT Journal
TC Experimental
CY United Kingdom
LA English

AB Common soots are disordered carbonaceous materials containing several per cent of heteroatoms. A question of some importance is to what extent pure carbon networks dominate the properties of common soots. The authors report the results of a comparative study of fullerene soots which are a form of pure partially ordered carbon and those formed from flaming polystyrene combustion which contain a few per cent of oxygen atoms, using electron diffraction, **electron spin resonance**

(ESR), infra-red transmission and measurements of electrical conductivity. It has been found that despite some important characteristic differences, the annealed fullerene soot and flaming polystyrene soot have a number of important structural, electrical and magnetic features in common, provided that the flame and annealing temperatures are the same. This suggests that the graphitic layer and **fullerene related tubular** structures found in these materials dominate the electrical properties of these soots regardless of the presence of small quantities of heteroatoms in the soot derived from the flaming combustion of polystyrene.

CC A6146 Solid clusters (including fullerenes) and nanoparticles; A7630 Electron paramagnetic resonance and relaxation; A8240P Flames, combustion, and explosions; A7830 Infrared and Raman spectra and scattering (condensed matter); A7290 Other topics in electronic transport in condensed matter

CT ANNEALING; COMBUSTION **SYNTHESIS**; ELECTRICAL CONDUCTIVITY; ELECTRON DIFFRACTION; FLAMES; FULLERENES; INFRARED SPECTRA; PARAMAGNETIC RESONANCE

ST extended C network effect; structural properties; electrical properties; magnetic properties; common soot; disordered carbonaceous materials; heteroatoms; fullerene soots; pure partially ordered C; flaming polystyrene combustion; electron diffraction; **electron spin resonance**; IR transmission; electrical conductivity; annealed fullerene soot; flaming polystyrene soot; graphitic layer; **fullerene related tubular structures**; C

CHI C el; C ss
ET C

L62 ANSWER 10 OF 12 INSPEC (C) 2003 IEE on STN
AN 1997:5743815 INSPEC DN A9724-6146-011
TI Nanometre-size tubes of carbon.
AU Ajayan, P.M. (Dept. of Mater. Sci. & Eng., Rensselaer Polytech. Inst., Troy, NY, USA); Ebbesen, T.W.
SO Reports on Progress in Physics (Oct. 1997) vol.60, no.10, p.1025-62. 129 refs.

Doc. No.: S0034-4885(97)65225-2
Published by: IOP Publishing
Price: CCCC 0034-4885/97/101025+38\$59.50
CODEN: RPPHAG ISSN: 0034-4885
SICI: 0034-4885(199710)60:10L:1025:NSTC;1-A

DT Journal
TC General Review
CY United Kingdom
LA English

AB We review the present state of understanding of the structure, growth and properties of nanometre-size tubes of carbon. Two different types of

carbon **nanotubes**, namely single-shell **nanotubes** made of single layers of graphene cylinders and multishell **nanotubes** made of concentric cylinders of graphene layers have now become available. The subtle structure parameters such as helicity in the carbon network and the nanometre diameters give the **nanotubes** a rich variety in physical properties. Recent experimental progress on the measurements of properties using electron-energy loss spectroscopy, Raman spectroscopy, **electron-spin resonance**, electrical conductance, mechanical stiffness and theoretical predictions on electronic and mechanical properties of **nanotubes** are discussed. In addition to **synthesis** techniques, methods to purify and make aligned arrays of **nanotubes** are described. Different approaches for **fabricating** composite structures using **nanotubes** as moulds and templates and their future implications in materials science are evaluated. Finally, promising areas of future applications, for example as tiny field-emitting devices, micro-electrodes, nanoprobe and hydrogen storage material are outlined.

CC A6146 Solid clusters (including fullerenes) and nanoparticles; A6480G Microstructure; A6116N EPR and NMR determinations of structures

CT CARBON; EPR SPECTROSCOPY; NANOSTRUCTURED MATERIALS; NANOTECHNOLOGY; RAMAN SPECTROSCOPY

ST nanometre-size tubes; **carbon nanotubes**; **single-shell nanotubes**; graphene cylinders; **multishell nanotubes**; concentric cylinders; graphene layers; helicity; electron-energy loss spectroscopy; Raman spectroscopy; **electron-spin resonance**; electrical conductance; mechanical stiffness; mechanical properties; composite structures; field-emitting devices; micro-electrodes; nanoprobe; hydrogen storage material; C

CHI C el

ET C

L62 ANSWER 11 OF 12 INSPEC (C) 2003 FIZ KARLSRUHE on STN

AN 1997:5735231 INSPEC DN A9723-6146-031

TI Carbon **nanotubes** films: electronic properties and their application as field emitters.

AU de Heer, W.A.; Bonard, J.M.; Stoeckli, T.; Chatelain, A. (Dept. de Phys., Ecole Polytech. Federale de Lausanne, Switzerland); Forro, L.; Ugarte, D.

SO Zeitschrift fur Physik D (Atoms, Molecules and Clusters) (May 1997) vol.40, no.1-4, p.418-20. 18 refs.

Published by: Springer-Verlag

CODEN: ZDACE2 ISSN: 0178-7683

SICI: 0178-7683(199705)40:1/4L.418:CNFE;1-T

Conference: Eighth International Symposium on Small Particles and Inorganic Clusters. Copenhagen, Denmark, 1-6 July 1996

Sponsor(s): Augustinus Fonden; Carlsbergfondet; Danish Center for Nanostructures; Danfysk; et al

DT Conference Article; Journal

TC Experimental

CY Germany, Federal Republic of

LA English

AB Aligned carbon **nanotube** films have been studied with a wide variety of characterization techniques. Although **nanotubes** resemble bulk graphite as far as carrier densities, susceptibilities and conductivities are concerned, transport properties and ESR measurements indicate that carrier localization occurs at low temperatures. **Nanotube** films are good field emitters producing large currents at relatively low electric fields. The performance is superior to the intensely studied CVD diamond films in particular for the threshold field for electron emission. We believe that the observed remarkable electron emission is related to the special electronic

structure of the **nanotube** tips.

CC A6146 Solid clusters (including fullerenes) and nanoparticles; A7360F Electronic properties of semiconductor thin films; A7970 Field emission and field ionization; A7630 Electron paramagnetic resonance and relaxation; A7540G Dynamic properties of magnetic materials; A7220F Low-field transport and mobility; piezoresistance (semiconductors/insulators); A7220J Charge carriers: generation, recombination, lifetime, and trapping (semiconductors/insulators)

CT ATOMIC CLUSTERS; CARBON; CARRIER DENSITY; ELECTRICAL CONDUCTIVITY; ELECTRON FIELD EMISSION; ELECTRONIC STRUCTURE; MAGNETIC SUSCEPTIBILITY; NANOSTRUCTURED MATERIALS; PARAMAGNETIC RESONANCE; SEMICONDUCTOR THIN FILMS

ST electron field emitters; **aligned carbon nanotube films**; carrier densities; magnetic susceptibility; electrical conductivity; ESR measurements; **electron spin resonance measurements**; carrier localization; threshold field; electronic structure; **nanotube tips**; C

CHI C el

ET C

L62 ANSWER 12 OF 12 INSPEC (C) 2003 IEE on STN

AN 1997:5719576 INSPEC DN A9722-7630P-003

TI Room temperature **electron spin resonance** of the purified carbon **nanotubes** produced in different helium pressures.

AU Zhang Hai-yan (Dept. of Math. & Phys., Guangdong Univ. of Technol., Guangzhou, China); Wang Deng-yu; Xue Xin-min; He Yan-yang; Wu Ming-mei; Peng Shao-qi

SO Chinese Physics Letters (1997) vol.14, no.8, p.625-8. 12 refs. Published by: Chinese Phys. Soc Price: CCCC 0256-307X/97/\$50.00 CODEN: CPLEEU ISSN: 0256-307X SICI: 0256-307X(1997)14:8L.625:RTES;1-G

DT Journal

TC Experimental

CY China

LA English

AB The **electron spin resonance** (ESR) of purified carbon **nanotubes** prepared under different helium pressures from 20.0 to 80.0 kPa in are discharge has been measured. The dependence of the ESR **spin** density, linewidth and g value of the purified **nanotubes** on the helium pressure is found. The electronic properties of purified **nanotubes** varying with He pressure are discussed.

CC A7630P EPR of conduction electrons; A6146 Solid clusters (including fullerenes) and nanoparticles

CT CARBON; EPR LINE BREADTH; G-FACTOR; NANOSTRUCTURED MATERIALS

ST **room temperature electron spin resonance; purified C-nanotubes; purified carbon nanotubes; ESR spin density; linewidth; g value; 20 to 80 kPa; C**

CHI C el

PHP pressure 2.0E+04 to 8.0E+04 Pa

ET He; C

FYI only - dates are after 1999.

=> d L67 1-16 all

L67 ANSWER 1 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
 AN 2003(24):925 COMPENDEX
 TI Feasibility studies of magnetic particle-embedded carbon **nanotubes** for perpendicular recording media.
 AU Kuo, Cheng Tzu (Dept. of Materials Sci. and Eng. National Chiao Tung University, Hsinchu 300, Taiwan); Lin, Chao Hsun; Lo, An Ya
 SO Diamond and Related Materials v 12 n 3-7 March/July 2003 2003.p 799-805
 CODEN: DRMTE3 ISSN: 0925-9635
 PY 2003
 DT Journal
 TC Theoretical; Experimental
 LA English
 AB Nano-sized magnetic particles were successfully used as the catalysts to **synthesize** magnetic metal-encapsulated carbon **nanotubes** (CNTs) or nanoparticles on Si wafers in a **microwave plasma electron cyclotron resonance chemical vapor deposition (ECR-CVD)** system with CH₄ and/or H₂ as source gases. The magnetic catalyst materials, including Fe-Pt, Co-Pt, Nd₂Fe₁₄B, Fe and Fe-Ni, were first deposited on Si wafers by a physical vapor deposition (PVD) method, with subsequent plasma treatment for nanoparticle transformation. The main process parameters include catalyst materials, hydrogen plasma catalyst pretreatment and deposition temperature. For applications in magnetic media, the process has the following advantages: perpendicularly-aligned CNTs or nanoparticles; tip-growth CNTs; well-distributed magnetic particles; detectable magnetic field in each particle; high tube number density (up to 134 Gtubes/inch² for Fe-assisted CNTs); favorable catalyst size; higher shape and induced anisotropy; and nanostructures that can be manipulated. The catalyst particle sizes of Fe, Nb₂Fe₁₄B and Fe-Pt (35-40 nm in diameter) are uniform and greater than but close to the critical optimum size or single domain size, which favor a higher coercive force. The greatest coercive force can reach 750 Oe for Fe-assisted CNTs at a deposition temperature of 715 deg C, which is comparable with values reported in the literature. The coercive force difference between the vertical and horizontal directions can reach 300 Oe for Fe-assisted CNTs, and 355 Oe for Nb₂Fe₁₄B-assisted CNTs.
 . \$CPY 2002 Elsevier Science B.V. 15 Refs.
 CC 933.1 Crystalline Solids; 708.4 Magnetic Materials; 714.2 Semiconductor Devices and Integrated Circuits; 802.2 Chemical Reactions; 803 Chemical Agents; 804 Chemical Products Generally
 CT *Carbon **nanotubes**; Silicon wafers; **Chemical vapor deposition**; Magnetic recording; Anisotropy; Electron cyclotron resonance; Catalysts; Magnetic materials
 ST Magnetic catalysts
 ET Si; H; Fe*Pt; Fe sy 2; sy 2; Pt sy 2; Fe-Pt; Co*Pt; Co sy 2; Co-Pt; Fe*Nd; Nd sy 2; Nd₂Fe; Nd cp; cp; Fe cp; Fe; Fe*Ni; Ni sy 2; Fe-Ni; B*Fe*Nb; B sy 3; sy 3; Fe sy 3; Nb sy 3; Nb₂Fe₁₄B; Nb cp; B cp; Fe*Nb; Nb sy 2; Nb₂Fe

L67 ANSWER 2 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
 AN 2003(8):5280 COMPENDEX
 TI Template-directed **CVD** of dielectric **nanotubes**.
 AU Zambov, Ludmil (Dow Corning Corporation Mail # C041B1, Midland, MI 48686-0994, United States); Zambova, Adriana; Cabassi, Marco; Mayer, Theresa S.
 SO Advanced Materials v 15 n 1 Jan 3 2003 2003.p 26-33
 CODEN: ADVMEW ISSN: 0935-9648
 PY 2003
 DT Journal

- TC Theoretical; Experimental
LA English
AB **Fabrication** of dielectric **nanotubes** from silicon dioxide and silicon nitride by a template-based electron cyclotron resonance (ECR) plasma-enhanced (PE) CVD is described. The **nanotubes synthesized** from SiH₄-O₂ and SiH₄-N₂ binary source reagent systems are smooth, transparent and at least 10 μm long. A mathematical description of the template-directed nanometer-scale CVD is developed to elucidate the appropriate process parameters that enable growth of high-aspect-ratio **nanotubes** with uniform wall thickness. The analysis of the model, by establishing general trends between process operating conditions and geometrical characteristics of the **nanotubes**, clarifies the mechanism of nanoscale CVD. The dielectric **nanotubes** obtained provide many opportunities for **fabricating** composite nanostructures and nanodevices. 49
Refs.
- CC 802.2 Chemical Reactions; 932.3 Plasma Physics; 933.1 Crystalline Solids; 708.1 Dielectric Materials; 931.3 Atomic and Molecular Physics; 921 Applied Mathematics
CT *Plasma enhanced **chemical vapor deposition**; Dielectric materials; **Nanotubes**; Mathematical techniques; Electron cyclotron resonance; Composite materials
ST Nanodevices
ET H*Si; SiH; Si cp; cp; H cp; O; N
- L67 ANSWER 3 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(1):6178 COMPENDEX
TI Growth of the large area horizontally-aligned carbon **nanotubes** by **ECR-CVD**.
AU Hsu, Chih Ming (Dept. of Mat. Sci. and Engineering National Chiao Tung University, Hsinchu 300, Taiwan); Lin, Chao Hsun; Chang, Hui Lin; Kuo, Cheng Tzu
SO Thin Solid Films v 420-421 (Dec 2 2002 2002.p 225-229
CODEN: THSFAP ISSN: 0040-6090
PY 2002
DT Journal
TC Theoretical; Experimental
LA English
AB For potential applications of carbon **nanotubes (CNTs)** as connectors in microelectronic devices, the process to **synthesize** the large area horizontally-aligned **CNTs** on 100 mm (4 inch) Si wafers was developed, using electron cyclotron resonance **chemical vapor deposition**, with CH₄ and H₂ as the source gases and Co as the catalyst. The results show that vertical and horizontal **CNTs** can be obtained by manipulating the electric field applied on the substrate and flow direction of the gases. In the present deposition conditions, the horizontal **CNTs** show better field emission properties than vertical **CNTs**. This may be due to the blocking effect of catalysts at the tips and to the diminishment of the effective emission area from defects of vertical **CNTs** body. \$CPY 2002 Elsevier Science B.V. All rights reserved. 34
Refs.
- CC 933.1 Crystalline Solids; 713 Electronic Circuits; 802.2 Chemical Reactions; 714.2 Semiconductor Devices and Integrated Circuits; 931.2 Physical Properties of Gases, Liquids and Solids; 803 Chemical Agents
CT *Carbon **nanotubes**; **Synthesis** (chemical); Silicon wafers; Gases; Catalysts; Electron cyclotron resonance; Scanning electron microscopy; Microelectronics; **Chemical vapor deposition**
ST Electron cyclotron resonance **chemical vapor**

deposition (ECR-CVD)
ET Si; H; Co

L67 ANSWER 4 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2003(1):6176 COMPENDEX
TI Effect of bias voltage on the formation of a-C:N nanostructures in **ECR** plasmas.
AU Liu, X.W. (Dept. of Mat. Sci. and Engineering National Tsing Hua University, Hsinchu 300, Taiwan); Chan, L.H.; Hong, K.H.; Shih, H.C.
SO Thin Solid Films v 420-421 Dec 2 2002 2002.p 212-218
CODEN: THSFAP ISSN: 0040-6090
PY 2002
DT Journal
TC Theoretical; Experimental
LA English
AB Amorphous carbon nitride (a-C:N) **nanotubes** and **nanofibers** on porous alumina templates were **synthesized** by an electron cyclotron resonance **chemical vapor deposition** system in which a variable negative d.c. bias was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nano-channels of the alumina template in **microwave** excited plasmas of C₂H₂ or N₂. The aligned structures of a-C:N **nanotubes** or **nanofibers** were verified by field emission scanning electron microscopy. Transmission electron microscopy micrographs showed that a-C:N **nanotubes** and **nanofibers** were the size with a diameter of [similar to] 100-250 nm and a length of [similar to] 50-80 μ m. The amorphous nature of the nanostructures was confirmed by the absence of crystalline phases arising from selected area diffraction patterns. X-ray photoelectron spectroscopy spectra indicated that a-C:N **nanotubes** and **nanofibers** were composed of nitrogen and carbon, and the N/C ratios could reach as high as 72%. The absorption bands between 1250 and 1750 cm⁻¹ in Fourier transform infrared spectroscopy provided direct evidence for the presence of nitrogen atoms in the amorphous carbon network. The well-aligned a-C:N **nanotubes** and **nanofibers** are expected to have potential applications in optical, electronic and optoelectronic devices. \$CPY 2002 Elsevier Science B.V. All rights reserved. 43 Refs.
CC 933.1 Crystalline Solids; 701.1 Electricity: Basic Concepts and Phenomena; 802.2 Chemical Reactions; 932.3 Plasma Physics; 931.3 Atomic and Molecular Physics; 741.3 Optical Devices and Systems
CT *Nanostructured materials; **Synthesis** (chemical); **Chemical vapor deposition**; Electric potential; Electron cyclotron resonance; Transmission electron microscopy; Plasma applications; Carbon **nanotubes**
ST **Nanofibers**
ET C*N; C:N; N doping; doped materials; C*H; C₂H; C cp; cp; H cp; N

L67 ANSWER 5 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
AN 2002(29):210 COMPENDEX
TI Morphology and characterization of highly nitrogenated, aligned, amorphous carbon nano-rods formed on an alumina template by **ECR-CVD**.
AU Liu, X.W. (Department of Materials Science/Eng. National Tsing Hua University, Hsinchu 300, Taiwan); Lin, J.H.; Hsieh, W.J.; Shih, H.C.
SO Diamond and Related Materials v 11 n 3-6 March/June 2002 2002.p 1193-1199
CODEN: DRMT3 ISSN: 0925-9635
PY 2002
DT Journal
TC Experimental
LA English

- AB Highly nitrogenated amorphous carbon (a-C:N) nano-rods on a porous alumina template were **synthesized** using an electron cyclotron resonance **chemical vapor deposition** (ECR-CVD) system, in which a negative DC bias was applied to the graphite substrate holder to promote the flow of ionic fluxes through the nano-channels of the alumina template in a **microwave**-excited plasma of C₂H₂ and N₂ as precursors. The aligned structure of a-C:N nano-rods was verified by field-emission scanning electron microscopy (FE-SEM). Transmission electron microscopy (TEM) micrographs of a-C:N nano-rods showed that the nano-rods are well aligned with a diameter of approximately 100-250 nm and a length of approximately 50-80 μ m. The amorphous nature of the nano-rods was confirmed by the absence of crystalline phases arising from selected-area diffraction (SAD) patterns. X-Ray photoelectron spectroscopy (XPS) spectra indicated that these nano-rods were composed of nitrogen and carbon, and the N/C ratios could reach as high as 56%. The absorption bands between 1250 and 1750 cm⁻¹ in Fourier-transform infrared (FTIR) spectra provided direct evidence for the effective incorporation of nitrogen atoms into the amorphous carbon network. Raman spectra showed the same feature, with a G-band at [similar to]1580 and a D-band at [similar to]1370 cm⁻¹ in the amorphous carbon film. The well-aligned a-C:N nano-rods are expected to have potential applications in optic, electronic and optoelectronic devices. \$CPY 2002 Elsevier Science B.V. All rights reserved. 36 Refs.
- CC 933.1 Crystalline Solids; 933.2 Amorphous Solids; 802.2 Chemical Reactions; 931.2 Physical Properties of Gases, Liquids and Solids; 804 Chemical Products Generally; 804.2 Inorganic Components
- CT *Carbon **nanotubes**; Graphite; Fluxes; Transmission electron microscopy; Substrates; **Chemical vapor deposition**; Electron cyclotron resonance; Amorphous materials; **Synthesis** (chemical); Morphology; Nitrogen; Alumina; Porous materials
- ST Nitrogenation; Carbon nanorods
- ET C*N; C:N; N doping; doped materials; C*H; C₂H; C cp; cp; H cp; N; D
- L67 ANSWER 6 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN
- AN 2002(27):3428 COMPENDEX
- TI Well-aligned carbon **nanofibers synthesized** by electron cyclotron resonance **chemical vapor deposition**
- AU Hoshi, Fumiyuki (FCT Research Laboratory JFCC c/o NIMC, Ibaraki, Japan); Tsugawa, Kazuo; Goto, Akiko; Ishikura, Takefumi; Yamashita, Satoshi; Yumura, Motoo; Hirao, Takashi; Fujiwara, Shuzou; Koga, Yoshinori
- MT Nanotubes and Related Materials.
- ML Boston, MA, United States
- MD 27 Nov 2000-30 Nov 2000
- SO Materials Research Society Symposium - Proceedings v. 633. 2001.p A621-A626
CODEN: MRSPDH ISSN: 0272-9172
- PY 2001
- MN 59215
- DT Conference Article
- TC Experimental
- LA English
- AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW ECR-CVD method using methane and argon mixture gas at the temperature of 550deg C. Carbon **nanofibers** and hollow carbon **nanofibers** were deposited perpendicularly on Si substrate and on Si substrate coated with Ni catalyst respectively. Raman spectra of aligned carbon **nanofibers** and hollow carbon **nanofibers** showed new bands of 1340 and 1612 cm⁻¹ of the first-order Raman scattering and 2660, 2940 and 3220 cm⁻¹ of

the second-order Raman scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro crystal graphite. Combination bands are intense unusually. Field emitter characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were investigated and the current densities were 7.25 mA/cm² and 0.69 mA/cm² at 12.5 V/μm, respectively. 8 Refs.

CC 933.1 Crystalline Solids; 931.3 Atomic and Molecular Physics; 802.2 Chemical Reactions; 933.1.2 Crystal Growth; 804.1 Organic Components; 803 Chemical Agents

CT *Carbon **nanotubes**; Electron emission; Methane; Argon; Catalysts; Raman scattering; Band structure; Electron cyclotron resonance; **Chemical vapor deposition**; Crystal growth

ST Carbon **nanofibers**

ET Si; Ni

L67 ANSWER 7 OF 16 COMPENDEX COPYRIGHT 2003 EEI on STN

AN 2000(32):247 COMPENDEX

TI **Synthesis** and characterization of the aligned hydrogenated amorphous carbon **nanotubes** by electron cyclotron resonance excitation.

AU Tsai, S.H. (Nat'l Tsing Hua Univ, Hsinchu, Taiwan); Chiang, F.K.; Tsai, T.G.; Shieu, F.S.; Shih, H.C.

SO Thin Solid Films v 366 n 1-2 May 1 2000 p 11-15
CODEN: THSFAP ISSN: 0040-6090

PY 2000

DT Journal

TC Experimental

LA English

AB Aligned hydrogenated amorphous carbon **nanotubes** on porous (anodic alumina have been **synthesized** by electron cyclotron resonance **chemical vapor deposition** (ECR-CVD) using the precursor gases, acetylene and argon. The composite film, with the aligned hydrogenated amorphous carbon **nanotubes** embedded in the porous anodic alumina, was found to be robust and is expected to have potential application in optic, electronic and optoelectronic devices. It is possible to prepare a large area of such a film by taking advantages of the ECR-CVD process, e.g. high plasma density at low temperature, less ionic damage, contamination-free and high deposition rate. By adjusting the pore size of anodic alumina, hydrogenated amorphous carbon **nanotubes** of various diameters can be **produced** in a range from 230 down to 30 nm. Characterization of the **nanotubes** in anodic alumina was carried out by field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), transmission electronic microscopy (TEM) and electron energy loss spectroscopy (EELS). The results indicate that the **nanotubes** consist of amorphous hydrogenated carbon, which are grown at a temperature of approx. 100 degree C for 4 min. (Author abstract) 20 Refs.

CC 804.2 Inorganic Components; 933.1 Crystalline Solids; 933.2 Amorphous Solids; 802.2 Chemical Reactions; 931.3 Atomic and Molecular Physics; 804.1 Organic Components

CT *Carbon; Argon; Hydrogenation; Characterization; Electron cyclotron resonance; Alumina; **Chemical vapor deposition**; Acetylene; **Nanotubes**; Amorphous materials

ST Amorphous hydrogenated carbon; Porous anodic alumina; Composite film

ET C

L67 ANSWER 8 OF 16 INSPEC (C) 2003 IEE on STN

AN 2003:7654428 INSPEC DN A2003-14-6148-012

- TI Effect of ion bombardment on microstructures of carbon **nanotubes** grown by electron cyclotron resonance **chemical vapor deposition** at low temperatures.
- AU Yun-Sung Woo (Dept. of Mater. Sci. & Eng., Korea Adv. Inst. of Sci. & Technol., Taejeon, South Korea); In-Taek Han; Young-Jun Park; Ha-Jin Kim; Jae-Eun Jung; Nae-Sung Lee; Duk-Young Jeon; Kim, J.M.
- SO Japanese Journal of Applied Physics, Part 1 (Regular Papers, Short Notes & Review Papers) (March 2003) vol.42, no.3, p.1410-13. 22 refs.
Published by: Japan Soc. Appl. Phys
CODEN: JAPNDE ISSN: 0021-4922
SICI: 0021-4922(200303)42:3L.1410:EBMC;1-X
- DT Journal
TC Experimental
CY Japan
LA English
- AB Vertically aligned multi walled carbon **nanotubes** (**MWNTs**) were **synthesized** by electron cyclotron resonance **chemical vapor deposition** on Ni-coated glass substrates at temperatures as low as 400 degrees C. Negative self-biases were applied to the substrates by radio-frequency (RF) plasma for ion bombardment of the growing surface. It was observed that ion bombardment by RF biasing to the substrates had a great effect upon the growth of carbon **nanotubes** and their morphologies. High-resolution transmission electron microscopy revealed that the degree of ordering of graphene layers in the **synthesized nanotubes** increased with RF bias. Raman spectroscopic analyses indicated that the shortening of C-C bonds within the graphene layers of the **MWNTs** occurred at larger negative biases, which seemed to result from removal of bonded hydrogen from the **MWNTs** by ion bombardment.
- CC A6148 Structure of fullerenes and fullerene-related materials; A8115H Chemical vapour deposition; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6180J Ion beam effects; A7830G Infrared and Raman spectra in inorganic crystals
- CT CARBON **NANOTUBES**; ION BEAM EFFECTS; PLASMA **CVD**; RAMAN SPECTRA; TRANSMISSION ELECTRON MICROSCOPY
- ST **multiwalled carbon nanotubes**; **ECR-CVD**; Ni-coated glass substrates; RIF biasing; ion bombardment; HRTEM; graphene layers; Raman spectra; 400 degC; C
- CHI C el
PHP temperature 6.73E+02 K
ET Ni; C; C-C
- L67 ANSWER 9 OF 16 INSPEC (C) 2003 IEE on STN
AN 2003:7635573 INSPEC DN A2003-13-8115H-114
- TI Growth of the large area horizontally-aligned carbon **nanotubes** by **ECR-CVD**.
- AU Chih Ming Hsu; Chao Hsun Lin; Hui Lin Chang; Cheng Tzu Kuo (Dept. of Mater. Sci. & Eng., Nat. Chiao Tung Univ., Hsinchu, Taiwan)
- SO Thin Solid Films (2 Dec. 2002) vol.420-421, p.225-9. 34 refs.
Doc. No.: S0040-6090(02)00799-X
Published by: Elsevier
Price: CCCC 0040-6090/02/\$22.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20021202)420/421L.225:GLAH;1-B
Conference: 29th International Conference on Metallurgical Coatings and Thin Films. San Diego, CA, USA, 22-26 April 2002
- DT Conference Article; Journal
TC Experimental
CY Switzerland
LA English

- AB For potential applications of carbon **nanotubes** (CNTs) as connectors in microelectronic devices, the process to **synthesize** the large area horizontally-aligned CNTs on 100 mm (4 inch) Si wafers was developed, using electron cyclotron resonance **chemical vapor deposition**, with CH₄ and H₂ as the source gases and Co as the catalyst. The results show that vertical and horizontal CNTs can be obtained by manipulating the electric field applied on the substrate and flow direction of the gases. In the present deposition conditions, the horizontal CNTs show better field emission properties than vertical CNTs. This may be due to the blocking effect of catalysts at the tips and to the diminishment of the effective emission area from defects of vertical CNTs body.
- CC A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A6865 Low-dimensional structures: growth, structure and nonelectronic properties; A7970 Field emission and field ionization
- CT **CARBON NANOTUBES; CHEMICAL VAPOUR DEPOSITION; CRYSTAL DEFECTS; FIELD EMISSION; SCANNING ELECTRON MICROSCOPY**
- ST **horizontally-aligned carbon nanotubes; ECR-CVD;** microelectronic devices; connectors; Co catalyst; field emission; blocking effect; defects; SEM; C; Si; Co
- CHI C el; Si sur, Si el; Co el
- ET Si; C*H; CH₄; C cp; cp; H cp; H₂; Co; C
- L67 ANSWER 10 OF 16 INSPEC (C) 2003 IEE on STN
- AN 2003:7635571 INSPEC DN A2003-13-8115H-113
- TI Effect of bias voltage on the formation of a-C:N nanostructures in **ECR** plasmas.
- AU Liu, X.W.; Chan, L.H.; Hong, K.H.; Shih, H.C. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)
- SO Thin Solid Films (2 Dec. 2002) vol.420-421, p.212-18. 43 refs.
Doc. No.: S0040-6090(02)00798-8
Published by: Elsevier
Price: CCCC 0040-6090/2002/\$22.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20021202)420/421L:212:EBVF;1-D
- DT Journal
- TC Experimental
- CY Switzerland
- LA English
- AB Amorphous carbon nitride (a-C:N) **nanotubes** and **nanofibers** on porous alumina templates were **synthesized** by an electron cyclotron resonance **chemical vapor deposition** system in which a variable negative d.c. bias was applied to the substrate holder of graphite to promote the flow of ionic fluxes through the nano-channels of the alumina template in **microwave** excited plasmas of C₂H₂ or N₂. The aligned structures of a-C:N. **nanotubes** or **nanofibers** were verified by field emission scanning electron-microscopy. Transmission electron microscopy micrographs showed that a-C:N **nanotubes** and **nanofibers** were the size with a diameter of 100-250 nm and a length of 50-80 μ m. The amorphous nature of the nanostructures was confirmed by the absence of crystalline phases arising from selected area diffraction patterns. X-ray photoelectron spectroscopy spectra indicated that a-C:N **nanotubes** and **nanofibers** were composed of nitrogen and carbon, and the N/C ratios could reach as high as 72%. The absorption bands between 1250 and 1750 cm⁻¹ in Fourier transform infrared spectroscopy provided direct evidence for the presence of nitrogen atoms in the amorphous carbon

network. The well-aligned a-C:N **nanotubes** and **nanofibers** are expected to have potential applications in optical, electronic and optoelectronic devices.

- CC A8115H Chemical vapour deposition; A5275R Plasma applications in manufacturing and materials processing; A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A7830G Infrared and Raman spectra in inorganic crystals; A7960E Photoelectron spectra of semiconductors and insulators; A7125W Electronic structure of solid clusters and nanoparticles; A7820D Optical constants and parameters (condensed matter)
- CT ABSORPTION COEFFICIENTS; AMORPHOUS STATE; BINDING ENERGY; CARBON COMPOUNDS; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; **NANOTUBES**; PLASMA CVD; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA
- ST bias voltage; a-C:N nanostructures formation; **ECR plasmas**; **amorphous carbon nitride nanotubes**; **nanofibers**; porous alumina templates; **electron cyclotron resonance chemical vapor deposition**; graphite substrate holder; ionic flux flow; **microwave excited plasma**; field emission scanning electron-microscopy; transmission electron microscopy; X-ray photoelectron spectroscopy; absorption bands; Fourier transform infrared spectroscopy; binding energy; 100 to 250 nm; 50 to 80 micron; C:N
- CHI C:N bin, C bin, N bin, C el, N el, N dop
- PHP size 1.0E-07 to 2.5E-07 m; size 5.0E-05 to 8.0E-05 m
- ET C*N; C:N; N doping; doped materials; C*H; C2H2; C cp; cp; H cp; N2

L67 ANSWER 11 OF 16 INSPEC (C) 2003 IEE on STN

AN 2003:7612661 INSPEC DN A2003-12-8120V-027

TI Well-aligned carbon **nanofibers** synthesized by electron cyclotron resonance **chemical vapor deposition**

AU Hoshi, F.; Tsugawa, K.; Goto, A.; Ishikura, T. (FCT Res. Lab., Japan Fine Ceramics Center, Nagoya, Japan); Yamashita, S.; Yumura, M.; Hirao, T.; Fujiwara, S.; Koga, Y.

SO Nanotubes and Related Materials. Symposium (Mater. Res. Soc. Symposium Proceedings Vol. 633)
Editor(s): Rao, A.M.
Warrendale, PA, USA: Mater. Res. Soc., 2001. p.A6.2.1-6 of xiii+320 pp. 8 refs.

Conference: Boston, MA, USA, 27-30 Nov 2000

DT Conference Article

TC Experimental

CY United States

LA English

AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW **ECR-CVD** method using methane and argon mixture gas at the temperature of 550 degrees C. Carbon **nanofibers** and hollow carbon **nanofibers** were deposited perpendicularly on Si substrate and on Si substrate coated with Ni catalyst, respectively. Raman spectra of aligned carbon **nanofibers** and hollow carbon **nanofibers** showed new bands of 1340 and 1612 cm-1 of the first-order Raman scattering and 2660, 2940 and 3220 cm-1 of the second-order Raman scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro crystal graphite. Combination bands are intense unusually. Field emitter characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were investigated and the current densities were 7.25 mA/cm2 and 0.69 mA/cm2 at 12.5 V/ mu m, respectively.

- CC A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A7830G Infrared and Raman spectra in inorganic crystals
- CT CARBON FIBRES; **CHEMICAL VAPOUR DEPOSITION**; CURRENT DENSITY; NANOSTRUCTURED MATERIALS; RAMAN SPECTRA; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY
- ST **carbon nanofibers; electron cyclotron resonance chemical vapor deposition; ECR CVD**; methane; argon mixture gas; **hollow carbon nanofibers**; Ni catalyst; Raman spectra; first order Raman scattering bands; second order Raman scattering bands; overtone bands; combination bands; field emitter characteristics; current densities; micro crystal graphite; 550 C; 1340 cm⁻¹; 1612 cm⁻¹; 2660 cm⁻¹; 2940 cm⁻¹; 3220 cm⁻¹; C; Ni; Si
- CHI C el; Ni el; Si sur, Si el
- PHP temperature 8.23E+02 K; wavelength 7.46E-06 m; wavelength 6.203E-06 m; wavelength 3.76E-06 m; wavelength 3.40E-06 m; wavelength 3.11E-06 m
- ET C; Si; Ni
- L67 ANSWER 12 OF 16 INSPEC (C) 2003 IEE on STN
- AN 2002:7363088 INSPEC DN A2002-20-8120V-004
- TI Growth mechanism and properties of the large area well-aligned carbon nano-structures deposited by **microwave plasma electron cyclotron resonance-chemical vapor deposition**.
- AU Chao Hsun Lin; Hui Lin Chang; Ming Her Tsai; Cheng Tzu Kuo (Dept. of Mater. Sci. & Eng., Nat. Chiao Tung Univ., Hsinchu, Taiwan)
- SO Diamond and Related Materials (March-June 2002) vol.11, no.3-6, p.922-6. 17 refs.
Doc. No.: S0925-9635(01)00640-9
Published by: Elsevier
Price: CCCC 0925-9635/02/\$22.00
CODEN: DRMTE3 ISSN: 0925-9635
SICI: 0925-9635(200203/06)11:3/6L:922:GMPL;1-K
Conference: 12th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes, Nitrides and Silicon Carbide (Diamond 2001). Budapest, Hungary, 2-7 Sept 2001
- DT Conference Article; Journal
- TC Experimental
- CY Netherlands
- LA English
- AB Large area (4-inch diameter) well-aligned carbon nano-structures on Si substrate were successfully **synthesized** by using a catalyst-assisted **microwave plasma electron cyclotron resonance chemical vapor deposition (ECR-CVD)** system with CH₄ as source gas. The catalysts include Fe, Co and Ni. The catalysts and the deposited nano-structures were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), Raman and field emission I-V measurements. Effects of process parameters on morphologies, structures and properties of the nano-structures were examined. The results show that the deposited nano-structures can include normal **nano-tubes**, split catalyst **nano-tubes**, seaweed-like **nano**-sheets and carbon film, depending mainly on substrate temperature and bias, catalyst materials and their application methods. Deposition mechanisms for different nano-structures, especially, the unique split catalyst **nano-tubes** and seaweed-like nano-sheets, were proposed. The differences in oxidation resistance and field emission properties between different nano-structures will be compared and discussed.
- CC A8120V Preparation of fullerenes and fullerene-related materials,

intercalation compounds, and diamond; A5275R Plasma applications in manufacturing and materials processing; A6148 Structure of fullerenes and fullerene-related materials; A8230V Homogeneous catalysis; A7970 Field emission and field ionization

CT CARBON **NANOTUBES**; CATALYSIS; ELECTRON FIELD EMISSION; OXIDATION; PLASMA **CVD**; RAMAN SPECTRA; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY

ST large area well-aligned carbon nanostructures; growth mechanism; **microwave plasma ECR CVD**; catalyst-assisted processes; scanning electron microscopy; transmission electron microscopy; Raman measurements; field emission I-V measurements; morphologies; **normal nanotubes**; **split catalyst nanotubes**; seaweed-like nanosheets; substrate temperature; substrate bias; oxidation resistance; field emission properties; C

CHI C sur, C el

ET Si; C*H; CH₄; C cp; cp; H cp; Fe; Co; Ni; I*V; I-V; C

L67 ANSWER 13 OF 16 INSPEC (C) 2003 IEE on STN

AN 2002:7325665 INSPEC DN A2002-17-0130C-009; B2002-08-0100-096

TI Diamond, Diamond-Like Carbon and Related Materials. Symposium F of the International Conference on Materials for Advanced Technologies 2001.

SO International Journal of Modern Physics-B (20 March 2002) vol.16, no.6-7
Published by: World Scientific
CODEN: IJPBEV ISSN: 0217-9792
Conference: Diamond, Diamond-Like Carbon and Related Materials. Symposium F of the International Conference on Materials for Advanced Technologies 2001. Singapore, 11-6 July 2001

DT Conference Proceedings; Journal

CY Singapore

LA English

AB The following topics were dealt with: pulsed laser deposition; vacuum arc plasma deposition; diamond; plasma **CVD**; carbon **nanotubes**; DC magnetron sputtering; UV photodetectors; diffusion barriers; cathodic electrodeposition; crystallites **synthesis**; optical protective coatings; diamond detectors; **ECR-CVD**; **PECVD**; DLC coating tribology; magnetic storage media; flat panel displays; electron field emission; thermoluminescent dosimeters; antireflection coatings; STM; thermal conductivity and carbon nanocomposite films.

CC A0130C Conference proceedings; A8115I Pulsed laser deposition; A6855 Thin film growth, structure, and epitaxy; A8115G Vacuum deposition; A6148 Structure of fullerenes and fullerene-related materials; A6480G Microstructure; A5275R Plasma applications in manufacturing and materials processing; A8115H Chemical vapour deposition; A8115C Deposition by sputtering; A6220P Tribology; A8140P Friction, lubrication, and wear; A6670 Nonelectronic thermal conduction and heat-pulse propagation in nonmetallic solids; A7970 Field emission and field ionization; A8760M Radiation dosimetry in medical physics; A4280X Optical coatings; A0762 Detection of radiation (bolometers, photoelectric cells, i.r. and submillimetre waves detection); A8115L Deposition from liquid phases (melts and solutions); A8245 Electrochemistry and electrophoresis; B0100 General electrical engineering topics; B2520C Elemental semiconductors; B0520H Pulsed laser deposition; B0520D Vacuum deposition; B0520F Chemical vapour deposition; B0520B Sputter deposition; B2320 Electron emission, materials and cathodes; B7530B Radiation protection and dosimetry; B4190F Optical coatings and filters; B4110 Optical materials; B7230C Photodetectors; B0520J Deposition from liquid phases; B0550 Composite materials (engineering materials science); B7260B Display materials

CT ANTIREFLECTION COATINGS; CARBON; CARBON **NANOTUBES**; COMPOSITE MATERIALS; CRYSTALLITES; DIAMOND; DIFFUSION BARRIERS; ELECTRODEPOSITION; ELECTRON FIELD EMISSION; ELEMENTAL SEMICONDUCTORS; FLAT PANEL DISPLAYS;

MAGNETIC STORAGE; OPTICAL FILMS; PHOTODETECTORS; PLASMA CVD; PULSED LASER DEPOSITION; SEMICONDUCTOR GROWTH; SPUTTER DEPOSITION; THERMAL CONDUCTIVITY; THERMOLUMINESCENT DOSIMETERS; TRIBOLOGY; ULTRAVIOLET DETECTORS; VACUUM DEPOSITION

ST diamond-like C; pulsed laser deposition; vacuum arc plasma deposition; diamond; **plasma CVD**; **C nanotubes**; DC magnetron sputtering; UV photodetectors; diffusion barriers; cathodic electrodeposition; **crystallites synthesis**; optical protective coatings; diamond detectors; **ECR-CVD**; **PECVD**; DLC coating; tribology; magnetic storage media; flat panel displays; electron field emission; thermoluminescent dosimeters; antireflection coatings; STM; thermal conductivity; C nanocomposite films; C

CHI C el
ET F; C

L67 ANSWER 14 OF 16 INSPEC (C) 2003 IEE on STN
AN 2001:6896573 INSPEC DN A2001-10-7970-004; B2001-05-2320-008
TI Field emission and structure of aligned carbon **nanofibers** deposited by **ECR-CVD** plasma method.
AU Hoshi, F.; Tsugawa, K.; Goto, A.; Ishikura, T. (NIMC, Joint Res. Consortium of Frontier Carbon Technol., Ibaraki, Japan); Yamashita, S.; Yamura, M.; Hirao, T.; Oura, K.; Koga, Y.
SO Diamond and Related Materials (Feb. 2001) vol.10, no.2, p.254-9. 11 refs. Doc. No.: S0925-9635(00)00476-3
Published by: Elsevier
Price: CCCC 0925-9635/2001/\$20.00
CODEN: DRMTE3 ISSN: 0925-9635
SICI: 0925-9635(200102)10:2L:254:FESA;1-2
Conference: 3rd Specialist Meeting on Amorphous Carbon (SMAC 2000). Mondovi, Italy, 30 Aug-1 Sept 2000
DT Conference Article; Journal
TC Experimental
CY Switzerland
LA English
AB Aligned carbon **nanofibers** and hollow carbon **nanofibers** were grown by MW **ECR-CVD** method using methane and argon mixture gas at a temperature of 550 degrees C. The carbon **nanofibers** and the hollow carbon **nanofibers** were deposited perpendicularly on Si substrates and on Si substrates coated with Ni catalyst, respectively. From TEM analysis the diameter and length of the **nanofibers** are approximately 60 nm and 15 μ m, respectively Raman spectra of these aligned carbon **nanofibers** showed new bands of 1340 and 1612 cm^{-1} of the first-order Raman scattering and 2660, 2940 and 3220 cm^{-1} of the second-order Raman scattering. The second-order Raman scattering bands were assigned to two overtone and one combination bands on the basis of a similar assignment of micro-crystal graphite by Nemanich and Solin. By the measurement of XPS C1s band energies of 284.6 eV for the carbon **nanofiber** and 284.7 eV for the hollow carbon **nanofiber** indicate mainly sp² carbon component in the inclusion of a small amount (<5%) of oxygen in a high binding energy region (-288 eV). Field emission characteristics of the well-aligned carbon **nanofibers** and hollow carbon **nanofibers** were investigated and the current densities were 7.25 and 0.69 mA/cm² at 12.5 V/ μ m, respectively.
CC A7970 Field emission and field ionization; A6148 Structure of fullerenes and fullerene-related materials; A8120V Preparation of fullerenes and fullerene-related materials, intercalation compounds, and diamond; A5275R Plasma applications in manufacturing and materials processing; A6855 Thin film growth, structure, and epitaxy; A8115H Chemical vapour deposition; A8265J Heterogeneous catalysis at surfaces and other surface reactions;

- A6322 Phonons in low-dimensional structures and small particles; A7960G Photoelectron spectra of composite surfaces; A7830G Infrared and Raman spectra in inorganic crystals; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures); B2320 Electron emission, materials and cathodes; B0587 Fullerenes, carbon nanotubes, and related materials (engineering materials science); B0520F Chemical vapour deposition
- CT CARBON **NANOTUBES**; CATALYSTS; CRYSTAL STRUCTURE; CURRENT DENSITY; ELECTRON FIELD EMISSION; NICKEL; PHONON SPECTRA; PLASMA CVD; RAMAN SPECTRA; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA
- ST field emission; structure; **aligned carbon nanofibers**; **ECR-CVD plasma method**; **hollow carbon nanofibers**; MW **ECR-CVD method**; methane; argon; **carbon nanofibers**; Si substrates; Ni catalyst; TEM; Raman spectra; first-order Raman scattering; second-order Raman scattering; XPS C1s band energies; sp2 carbon component; current densities; 550 C; 60 nm; 15 μm ; 1340 to 3220 cm^{-1} ; C; Si; Ni
- CHI C el; Si sur, Si el; Ni sur, Ni el
- PHP temperature 8.23E+02 K; size 6.0E-08 m; size 1.5E-05 m; wavelength 3.11E-06 to 7.46E-06 m
- ET C; Si; Ni
- L67 ANSWER 15 OF 16 INSPEC (C) 2003 FIZ KARLSRUHE on STN
- AN 2000:6642970 INSPEC DN A2000-16-8120V-007
- TI **Synthesis** and characterization of the aligned hydrogenated amorphous carbon **nanotubes** by electron cyclotron resonance excitation.
- AU Tsai, S.H. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan); Chiang, F.K.; Tsai, T.G.; Shieu, F.S.; Shih, H.C.
- SO Thin-Solid-Films (1 May 2000) vol.366, no.1-2, p.11-15. 20 refs.
Doc. No.: S0040-6090(99)01105-0
Published by: Elsevier
Price: CCCC 0040-6090/2000/\$20.00
CODEN: THSFAP ISSN: 0040-6090
SICI: 0040-6090(20000501)366:1/2L:11:SCAH;1-X
- DT Journal
- TC Experimental
- CY Switzerland
- LA English
- AB Aligned hydrogenated amorphous carbon **nanotubes** on porous anodic alumina have been **synthesized** by electron cyclotron resonance **chemical vapor deposition (ECR-CVD)** using the precursor gases, acetylene and argon. The composite film, with the aligned hydrogenated amorphous carbon **nanotubes** embedded in the porous anodic alumina, was found to be robust and is expected to have potential application in optic, electronic and optoelectronic devices. It is possible to prepare a large area of such a film by taking advantages of the **ECR-CVD** process, e.g. high plasma density at low temperature, less ionic damage, contamination-free and high deposition rate. By adjusting the pore size of anodic alumina, hydrogenated amorphous carbon **nanotubes** of various diameters can be **produced** in a range from 230 down to 30 nm. Characterization of the **nanotubes** in anodic alumina was carried out by field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), transmission electronic microscopy (TEM) and electron energy loss spectroscopy (EELS). The results indicate that the **nanotubes** consist of amorphous hydrogenated carbon, which are grown at a temperature of 100 degrees C for 4 min.
- CC A8120V Preparation of fullerenes and fullerene-related materials,

intercalation compounds, and diamond; A7830L Infrared and Raman spectra in disordered solids; A7920K Other electron-surface impact phenomena; A8115H Chemical vapour deposition; A6148 Structure of fullerenes and fullerene-related materials; A7865V Optical properties of fullerenes and related materials (thin films/low-dimensional structures)

CT ALUMINA; AMORPHOUS STATE; CARBON **NANOTUBES**; COMPOSITE MATERIALS; ELECTRON ENERGY LOSS SPECTRA; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; HYDROGEN; INFRARED SPECTRA; PLASMA **CVD**; PLASMA **CVD** COATINGS; POROUS MATERIALS; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY

ST **carbon nanotubes**; hydrogenated amorphous carbon; electron cyclotron resonance excitation; alumina substrate; **CVD**; **chemical vapour deposition**; composite film; porous anodic alumina; plasma density; deposition rate; SEM; scanning electron microscopy; FTIR; TEM; transmission electron microscopy; EELS; electron energy loss spectroscopy; temperature dependence; 30 to 230 nm; C:H; Al₂O₃

CHI C:H bin, C bin, H bin, C el, H el, H dop; Al₂O₃ bin, Al₂ bin, Al bin, O₃ bin, O bin

PHP size 3.0E-08 to 2.3E-07 m

ET C; C*H; C:H; H doping; doped materials; Al*O; Al₂O₃; Al cp; cp; O cp; Al₂O; Al; O

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 AN 2000:6517297 INSPEC DN A2000-07-6146-015
 TI A novel form of carbon nitrides: well-aligned carbon nitride **nanotubes** and their characterization.
 AU Sung, S.L.; Tsai, S.H.; Liu, X.W.; Shih, H.C. (Dept. of Mater. Sci. & Eng., Nat. Tsing Hua Univ., Hsinchu, Taiwan)
 SO Journal of Materials Research (Feb. 2000) vol.15, no.2, p.502-10. 47 refs. Published by: Mater. Res. Soc
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 SICI: 0884-2914(200002)15:2L:502:NFCN;1-0

DT Journal
 TC Experimental
 CY United States
 LA English
 AB Well-aligned carbon nitride **nanotubes** were prepared with a porous alumina membrane as a template when using electron cyclotron resonance (ECR) plasma in a mixture of C₂H₂ and N₂ as the precursor with an applied negative bias to the graphite sample holder. The hollow structure and good alignment of the **nanotubes** were verified by field-emission scanning electron microscopy. Carbon nitride **nanotubes** were transparent when viewed by transmission electron microscopy, which showed that the **nanotubes** were hollow with a diameter of about 250 nm and a length of about 50-80 μ m. The amorphous nature of the **nanotubes** was confirmed by the absence of crystalline phases arising from selected-area diffraction patterns. Both Auger electron microscopy and X-ray photoelectron spectroscopy spectra indicated that these **nanotubes** are composed of nitrogen and carbon. The total N/C ratio is 0.72, which is considerably higher than other forms of carbon nitrides. No free-carbon phase was observed in the amorphous carbon nitride **nanotubes**. The absorption bands between 1250 and 1750 cm⁻¹ in Fourier transform infrared spectroscopy provided direct evidence for nitrogen atoms, effectively incorporated within the amorphous carbon network. Such growth of well-aligned carbon nitride **nanotubes** can be controlled by tuning the ECR plasma conditions and the applied negative voltage to the alumina template.

CC A6146 Structure of solid clusters, nanoparticles, and nanostructured materials; A8115H Chemical vapour deposition; A7960E Photoelectron spectra

of semiconductors and insulators; A6116D Electron microscopy determinations of structures; A7920F Electron-surface impact: Auger emission; A7830L Infrared and Raman spectra in disordered solids; A5275R Plasma applications in manufacturing and materials processing

CT AMORPHOUS STATE; AUGER ELECTRON SPECTRA; CARBON COMPOUNDS; CYCLOTRON RESONANCE; ELECTRON DIFFRACTION; FIELD EMISSION ELECTRON MICROSCOPY; FOURIER TRANSFORM SPECTRA; INFRARED SPECTRA; NANOSTRUCTURED MATERIALS; PLASMA **CVD**; SCANNING ELECTRON MICROSCOPY; TRANSMISSION ELECTRON MICROSCOPY; X-RAY PHOTOELECTRON SPECTRA

ST **well-aligned CN nanotubes**; porous alumina membrane; electron cyclotron resonance plasma; template; N₂; precursor; applied negative bias; graphite sample holder; hollow structure; field-emission scanning electron microscopy; transmission electron microscopy; diameter; amorphous nature; crystalline phases; selected-area diffraction patterns; Auger electron microscopy; X-ray photoelectron spectroscopy spectra; **amorphous CN nanotubes**; absorption bands; Fourier transform infrared spectroscopy; amorphous C network; applied negative voltage; CN

CHI N₂ el, N el; CN bin, C bin, N bin

ET C*H; C₂H₂; C cp; cp; H cp; N₂; C*N; CN; N cp; C; N